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THE EDITOR

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Abstract

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EDITORIAL

In the Journal of April 1947 Surgeon Rear Admiral Mason concluded his lecture at the Royal Naval Medical School with the observation that the School should be an active place, research is done and encouraged but even more importantly where the advances in knowledge are brought to the ordinary officer whether he be doctor or not. He would therefore be pleased to find the institutions which train today for research not only in the physiological and highly technical fields of modern naval medicine but also in the clinical specialties. It is a task of the new Institute to disseminate the knowledge they gained through its publications and post graduate teaching programmes, a recent example of which was a two day symposium on the practical applications of research into survival in a cold and wet environment.

With a view to encouraging and co-ordinating clinical research a Clinical Research Working Party was set up in 1945 under Surgeon Rear Admiral Stanley Miles as first Chairman. It now includes university professors, representatives of the Medical Research Council and Royal Naval Scientific Service and naval medical officers representing the fields of medicine and physiological training, naval hospitals and dutyships.

The Working Party has created a healthy climate for the exchange of ideas and the critical appraisal of proposals submitted by consultants and those training under their aegis. This has resulted in more effective utilization of the experienced resources which now exist and in the development of valuable links with university departments and research units throughout

Funds are available to enable promising projects to be commenced without delay.

The response to clinical research has been reflected in several contributions to the Journal and in the number possible statistical factors encountered in the high mortality of peptic ulceration amongst sailors, i.e. excretion. This project has turned the keys for a new pre-piloted study of all new cases by naval physicians and is designed for computer analysis of the comprehensive data being collected. The industrial research unit at HM Dockyard Devonport has produced a standard working endoscope design and is collaborating with the Medical Research Council as an important part project of national importance. Following publication of their findings, all trainee officers in dental post-graduate officers were invited by their American colleagues to discuss the implications at a recent meeting in the United States with a view to future joint collaboration and on the basis of his regional research into problems and techniques the consultant endoscopist in the Royal Naval Hospital Haslar is undertaking a series of lectures in Scandinavian universities.

One of the unattended results of re-organised departments is to dispel complacency and two newly created in the number three stations to practical problems of therapy in chemical and underwater fields which should prove valuable to naval medical officers.

But there is still a place for recruitment and this in the medical service of the modern Navy is well illustrated by the contribution of dental officers who take time off to take in Morocco and make professional contact out of a fleet exercise in the Pacific.

ARTICLES

FORMULA AND FASHION IN THE TREATMENT OF DECOMPRESSION SICKNESS IN DIVERS

By E. T. P. Ruard

Basic Principles

Decompression sickness may be regarded as an pathological disease of aviators, vessel workers and divers (Fig. 1). The most common factor leading to the production of symptoms or signs in these three groups is a pressing decompression that is to say a fall in the ambient atmospheric pressure.

Since the time of Paul Bert (1878) it has been recognized that ascending the

atmosphere permits gas to be liable to leaving the tissues and cause, or at least accelerate, the appearance of decompression sickness. The observation led to one of the accepted points of evidence for the pathological aetiological agents namely bubbles of gas, which are thought to be liberated from solution as a result of the original drop in pressure and which are reabsorbed when pressure is reapplied.

A second principle of treatment suggested by Bert was that the smallest amount of gas dissolved under pressure ought to be added by subsequently breathing oxygen.

The Application of Pressure

While certain minor variations there are three basic approaches, to the treatment of decompression sickness, of which the, either is probably the recommended by Bert to subject the patient to a pressure greater than that from which he rose. This treatment therefore retains the pressure to that of the working pressure (Fig. 2).

The second approach which is found in current copies of the Royal Naval Diving manual was a pressure at which relief of symptoms is obtained. It is thought that this approach may have been due to J. S. Haldane.

The third approach involves, taking the patient to an arbitrary pressure which has been calculated as being sufficient to re-absorb any hyperbaric bubble, which may be present and was due to Van Der



Fig. 1. Pathogenesis of decompression sickness.



FIG. 2. Applying the 100% Oxygen Unit to the Patient. (Courtesy of the U.S. Navy Medical Research and Development Command.)

Adv. *Hyperbaric Medicine*, **1**: 103-110 (1945).

Since the majority of pressure chambers are operated by divers, and not by doctors and since this is per se a confining physical constraint, it has been generally considered inadvisable to use the ordinary United States method of treatment except to offer the simplest guide to judgment by dividing the type of treatment according to the nature of the symptoms or signs.

The question of choice is not easy, since there are no experimental results which would favor one of the three general methods rather than another. The case proven by results is also difficult due to the different features given by patients and the different approaches of physicians who used to modify each treatment to suit the individual patient. The advantage of the present system is that they offer a ready made decompression table treatment or recompression has been completed. The turning to the working pressure or to the pressure of relief poses a new problem how to decompress from a more complex treatment than before.

The most satisfactory method in the author's opinion for the treatment of decompression sickness is a return to the pressure of relief although some add a

small recompression pressure. It is a useful practice to employ a three part question and to ask the patient, are you better, worse or the same? Any answer less than complete relief should lead to further recompression or an increase in pressure except in obvious cases. Care might early show more study than cases which have progressed well past for several hours. In these latter cases it may not be possible to obtain complete relief and a limited feeling is likely to persist.

The Duration of Therapeutic Exposure

As in selecting the pressure to which a man should be taken for treatment the selection of the time to be spent at the treatment pressure is also somewhat arbitrary. Times which have usually been recommended vary from one minute, reduction pressure (or 0 min) to 120 min at maximum pressure.

With few cases in the experience of any one physician it is not possible to be dogmatic about the time which should be spent at treatment pressure. The view which one takes will to some extent depend upon one's ideas as to the underlying pathology. In some cases there seems to be little difference between cases kept at pressure for 30, 60 and 90 minutes and 120 minutes may well be quite adequate in certain cases. Little seems to be gained by giving less than six hours at the pressure of relief and no difference can be seen between six and eight hours at pressure.

Made of Atmos

In returning to atmospheric pressure from the treatment pressure two main methods have been used.

First A tapered ascent in which a definite fall in pressure is followed by a pause at the new pressure and then followed by another fall in pressure and so on until the surface is reached. The

method (a kind of modified hyperbaric treatment) described by J. A. Workman (see workman 1963) and (3) oxygen breathing table, also the method described by J. A. Workman treatment table.

Secondly, a gradual and continuous fall in pressure, frequently called a bleed. This was used in the early practice of relief tables, and by Bernard (1967) for cases resulting in arterial gas embolism.

(3) Aerial stage of the decompression curve, varies from table to table and depends upon the underlying theory. Tables on one employ exponential or linear decompression and total combinations of both.

Breathing Systems

The nature of the gas breathed during treatment is usually dictated by logistics or economics. In the case of deepwater however, where air would produce nitrogen and oxygen would be toxic way below treatment tables used which employ:

- (a) Air only
- (b) Air followed by oxygen breathing when the total pressure falls below 2 bar
- (c) Oxygen breathing is provided up to 2.8 bar (d) Pure oxygen with air breathing
- (d) Dry helium mixtures

The normal consensus upon breathing mixtures is that the PO₂ should not be lower than about 0.16 bar, nor more than about 1.8 bar to avoid both hypoxia and toxicity. In using a r or high pressure the upper limit is reached at a pressure of 18 bar. However the oxygen recompression treatment of Goodman and Workman (1963) was a PO₂ of 2.8 bar. The rationale behind this is to employ a high oxygen to eliminate most gas in moderate pressure which reduces the time spent decompressing but to avoid oxygen toxicity by alternating air and oxygen breathing which is

described (see Goodman 1963) under the appropriate, alternative terms and treatment (1963).

Current Tables

What is aim to make of the mass of independent variables in selecting a sea table treatment table for any individual case of decompression sickness?

Current treatment tables which vary in their duration from about two hours to some two days, are numerous. This is partly because of the reluctance to obsolete tables which seem to work on basis of a rather simply learned system. A mixed master list with a large number of different treatments is however the difficulty of obtaining any satisfactory statistical analysis of the relative effectiveness of one table when compared with another.

The Royal Naval Diving Manual (1988) contains 10 treatment tables, without including any of those in use in current work and training.

A Suggested Scheme

It is suggested that the short oxygen air table (Table 6A, Fig 3 of Goodman and Workman (1963) is probably the best overall treatment for all cases of decompression sickness. The reason for this choice is that the time after which a diver can be made as fit whether or not



Fig. 3

no change tables in 10 minutes. Thus in most 10 minutes will have been reached but it will have been spent at a pressure of 1.5 bar breathing oxygen and in the event could be used in the meantime in case the treatment pressure is increased.

If this procedure has not produced complete relief in 10 minutes then the pressure should be increased to 3 bar (2 bar) breathing air where a relief is complete after 30 minutes return to sea atmosphere is made on Table 5B. Once again there is a liquid break point, the table is chosen to be adequate in terms of pressure and a further decrease can be taken in 50 minutes when the table is completed the instructions to move to a lower table if relief is incomplete.

If relief is not complete after 30 minutes at 3 bar then the time at maximum pressure may be extended to 120 minutes and decompression completed on Table 5D (Fig. 4).

The proposed treatment schedule may be represented schematically



Pharmacological and Other Agents

There is clearly a place in the treatment of decompression sickness for agents such as plasma and diuretic (Barwood, Barwood, Rowcliffe, Morgan, Finkle and Taly



Fig. 4

1968) in those cases presenting with hypovolaemic shock. Foster and Collett (1970) particularly recommend low molecular weight dextran combined with heparin treatment. Methylene blue has been used by Fink (1960) in cases of paralysis particularly those presenting late in the hope of relieving the extent of peroxan injury the toxic side presents. My feeling that nerve cells which are hypoxic will be able to survive longer if their oxygen consumption is reduced. The use of agents such as urea or mannitol to reduce oedema in the CNS is largely empirical, but they may be of assistance particularly where pressure facilities are not available. Such agents are used to reduce brain volume in neurosurgery but our interest is available to show whether some topical damage due to decompression will now lead to massive oedema, and to whether such oedema would respond to urea or mannitol.

There is some evidence that heparin may be of assistance in treatment after delivery (1963) and the morphine (Kilbuck) may relieve pain where this is a problem, but in the author's experience the use of these drugs appears to increase recovery delay to death.

The Future

The first important factor in the prevention of further treatment facilities in the

HEARTS AND MINDS IN THE PHILIPPINES

By G. E. Mathews

At 1150 local time we landed by LCM from HMAS INTREPID with the last wave of assault troops. The beach on the north west of Luzon, the largest island of the Philippines group had already been marked out and secured by the previous assault waves. From here we marched, by Land Rover with all Commando HQ Company, four miles inland to the town of Cebu. We set up our base with the Royal Marines in a dried up river bed to the west of the town.

Our team consisted of the doctor of 40 Commando Royal Marines, the chaplain, Chief Medical Assistant, two Landing Medical Assistants, one of whom was specially trained and myself. Our aim was to provide what medical aid we could for the local inhabitants during the period that the Royal Marines were ashore and not to retreat to American facilities (Fig 15).

After packing and reorganizing our tent and covering up our stores, whilst we



Fig. 15. LMA's with medical supplies on beach. (Figures 15-18 are by G. E. Mathews and G. E. Mathews, Commando, Royal Marines, 1964, from the Philippines).

called this a lucky discovery, also had been allowed of our project. We spent some time with them and went down the Government sponsored Health Center which then ran. It was the only one for some distance and provided medical facilities for children and pregnant women. As expected all dental treatment was at a private basis but we were assured that none of the local practitioners would have any objection to our working in the area. Next we were taken to a village locally known as a barrio on the shore two miles north of Caba. We stayed here for the rest of the afternoon explaining to the officials what we could do for them and dividing up the best venue for our clinic. We worked on the school since this made it easier to treat the children whom we considered as first priority in the project.

We then returned to headquarters and cleaned up. The headmaster at Wacaco had invited us to supper but we were disappointed by learning due to a full scale attack on Comodoro HQ. We were glad to find that it was well repelled but supper proved to be a most interesting experience not only from the point of sampling the local cuisine for the school's headmaster was very involved in local politics and we learned a lot about the Philippines way of life and hopes for their country.

Chile

Next morning we set up our clinic at 0800 after an early breakfast of mangoes and beans cooked on hot flat heaters. We had brought with us a master dental cabinet which holds a considerable range of foreign, American probes and instruments, also local anesthetics, and some orthophosphoric cement. Working until 1200 we saw about 150 patients including the majority of children in the school. Most of the children were suffering from rampant caries which is a little surprising considering that it is relatively poor area and the single dentist

the only dental practitioner. One did not conclude that the state is nearly unable to do the amount of money brought into the area by Smith East Asia Trading Corporation personnel when catering to the Philippines.

The only treatment possible in the majority of cases was extraction of painful teeth though where they could be salvaged I used them and put in a dressing of zinc phosphate cement. We had a slight but grave problem with the children, but the orthodontists came to our aid and we all got along towards. The children were rather confused by my chemical treatment since he used 4.4.4.4 and banded 19, silver and the Philippines do not achieve their dentitions. During the time we were there we were kept going by glasses of beautifully fresh coconut milk.

After lunch and a quick dip in the sea to cool off we drove five miles inland to another school at San Gonzales, where a group from HNS INTERMED was painting out one of the buildings. Again we set up shop and saw about 60 people mostly adults this time as the children were all going home.

Cariages

Although the adults gave a lot of local and chewing was so common but more interesting was the fact that many of the women in the villages indulged in the habit of intense cigar smoking. I saw half a dozen cases of leukoplakia of the palate who related to this habit and one woman of 21 who had the top incisors of carcinoma almost to the center of a large area of leukoplakia covering the whole of her hard palate. When asked why they did it the only very unsatisfactory answer I could get was to stop the smoke getting in our more stable smoking. The cigars were locally produced very sweet tobacco.

We were not able to get much data that night due to another "attack" on our camp.

THE SAILOR'S STOMACH*

By James Watt

Abstract

The incidence of peptic ulceration in the Royal Navy is higher than in a comparable civilian population and has been rising. It is highest in cadetship groups and lowest in active groups in which physical activity and job satisfaction appear to be important. Four factors appear directly responsible for the high incidence of peptic ulceration in sailors: the personality of those situated in a seagoing life, operational conditions associated with tension, responsibility and manpower shortages, inadequate physical activity, a diet high in refined carbohydrates. Contributory factors are smoking, alcohol, acute ulcerative oedipathies and intestinal parasites. Job satisfaction and physical fitness appear to reduce the risk. A link appears to exist between peptic ulceration and neuroticism in the Royal Navy. Gastric secretory studies have failed to provide meaningful information and high and low levels have been found in groups with the lowest incidence of peptic ulceration. Changes in eating arrangements, diet and conditions of service are unlikely to reduce the incidence of peptic ulceration.

Introduction

The problem of ulcer dyspepsia in the Royal Navy is complicated by the high incidence of ulcerative infections

endemic in the area in which the man has been serving. Dyspepsia is often the peevish symptom and considerable caution must be exercised in interpreting the results of standard investigations. Unexplained pathological evidence has therefore been regarded before considering peptic ulceration properly. During the years 1959-1968 dyspepsia accounted for 8,764 male hospital admissions in 317% of whom a radiologically proven peptic ulcer could be demonstrated.

By plotting the annual incidence it will be evident that ulceration is hospitalised far too often dyspepsia fell while the incidence of proven peptic ulceration was unaffected even many towards the end of this period (Fig. 1) at a time when in civilian practice, its incidence was falling. For instance, Senior and Jones (1962) report a recurrence of ulcer disease amongst young people in England and state that no improvement in diagnostic techniques has coincided with a decrease in ulcer incidence in this country so that the consistent improvement in diagnostic techniques in RN has



Fig. 1. A plot of peptic ulceration in the Royal Navy showing the annual incidence of ulceration and the annual incidence of peptic ulceration.

*From an original thesis on 'The Incidence, Aetiology and Treatment of Peptic Ulcer in the Royal Navy' published under the auspices of the Clinical Research Working Party, Institute of Naval Medicine, Whitehead, Bournemouth.

peaks cannot be expected to account for the increased incidence among RN personnel. Nor can it be assumed to mask hospital admission to hospital since all hospital statistics for the period under consideration have shown a significant trend in favor of out-patient care, even non and treatment rather than in-patient care in order to provide more beds for the emergency and more serious diseases, of an increasing civilian commitment in other words, paper absorption appears to be a possibility based on this at sea. Is this really the case?

Population Distribution

Any statistical review must take into account the comparison between the naval and the NHS male population distribution by plotting the cumulative percentage distribution of the two populations (Fig 2) it will be seen that 50 per cent of the Navy is below the age of 31, while 50 per cent of the NHS population is below the age of 35 and comparable populations must therefore be selected.

According to the Report on Hospital and In-Patient Inquiry for the year 1966 published by the Department of Health and Social Security the incidence of paper absorption per 10,000 NHS male population in England and Wales of all ages was 113. Calculated on the same basis the incidence of paper absorption in the Royal

Navy for the years 1959-1961 was 34.2. The disparity is greater when a comparable NHS male population between the ages of 15 and 34 is selected for then the incidence amongst civilian males becomes 14.4 and since the majority of naval patients are below the age of 35 when first issued the naval incidence of 34.2 per 10,000 might justifiably be compared with the NHS incidence of 102 for the comparable group.

It is however best to state that while the Report on Hospital In-Patient Inquiry for the year 1966 provides the only comparable statistics for the NHS population in England differ from those of other investigators. For instance Rodolph Freedman, Fisher and Whitwell (1970) report an incidence of proven duodenal ulcer of 42 per 10,000 for all age groups in 1964 on a stated general practice, but these probably represented the most severe populations within the practice and not the number of cases reported for treatment. It is possible that the general incidence across the country is higher than the NHS hospital statistics suggest although the absence of proper information regarding such important factors as the age spectrum precludes comparison with naval figures.

The administrative survey carried out by Doll, Avery Jones and Dickinson (1955) is probably the most accurate and contains the incidence of paper absorption in the male population of London between the ages of 15 and 34 as 32 per 10,000 persons. It is clear therefore that the incidence in the Royal Navy is higher than in London males of the height of the post-war ulcer epidemic in 1955. If the 10 year period, 1953-1963 is now divided into two five year periods, it can be shown that in spite of improved living and working conditions during the previous decade the incidence of proven paper absorption in RN males actually rose from 30.8 to 36.1 per 10,000 and this will require a further comment (Fig 3).



Fig 2. Army and NHS population distribution



Fig. 7. Distribution of incidence of mental illness amongst Royal Marine and other groups.



Fig. 8. Distribution of incidence of mental illness amongst Royal Marine and other groups.

Technical. For instance mental disorders have been included in the Executive group while Other is made up principally of communications medical branch and other voluntary miscellaneous personnel. It is obvious that the Royal Marine group has an apparently low incidence rate, and also a low appearance rate. This implies that the incidence of paper alterations in the Royal Marines is lower than amongst other groups. On the other hand the Technical group who might be expected to have more stress, also had a lower incidence of paper effect but voluntary groups such as the Supply Branch and Other groups have a relatively higher incidence. This is interesting in the light of the findings of Bell *et al.* (1954) who reported a lower incidence in agricultural workers whilst active members but higher in some respects compared with that of the Royal Marines but they reported a lower incidence in voluntary workers who would compare with Supply and Other groups who appear to have a higher incidence within the mental population.

In order to establish the validity of these findings the documents of a 1421 sample of the 1976 male paper alteration for the years 1959-69 were obtained from central records for working. Figure 7 is a histogram of the branch distribution in this sample which correlates well with Fig. 6, confirming the lower incidence in

the Royal Marine and Technical groups and the higher incidence in the Supply and Other groups. Applying the chi-square test to the distribution $\chi^2 = 21.6$ which for four degrees of freedom is highly significant with a probability of less than 0.0001. It is therefore reasonable to assume that Fig. 7 is a fair representation of the distribution of paper alterations on a branch basis. It has a number of important implications.

Incidence

While the number of cases over time did appear to follow the general pattern of incidence of prison paper alterations the annual percentage of cases were calculated that 22 years consistently from 11.9 per cent in 1959 reaching a peak of 15.5 per cent in 1961 to a low of 10.1 per cent in 1963 rising again to 10.6 per cent



Fig. 9. Incidence of mental illness amongst Royal Marine and other groups.

in 1954 and thereafter steadily falling to 8.8 per cent in 1965.

It would appear that the percentage of cases included is determined largely by the view of the individual hospital clinician regarding what he believes to be the place of surgery in the treatment of peptic ulcer, particularly in respect of the younger age groups where it has already been shown that the rate of re-laparotomy is high. The recent decline in the rate of re-laparotomy appears to have been determined more by the termination of various medical trials of new drugs and the surrender of failed patients to the surgeons than by any significant change of policy by referring physicians.

In the light of these findings, the question must be asked whether more peptic ulcer patients could be referred to a unit where shortages of manpower and problems of recruitment make it desirable to select so many patients as possible to duty within the service. There is some evidence that those with duodenal ulceration are often recruited through allegiance to a policy of avoiding the young peptic ulcer patients without the option of surgery in spite of evidence of the unacceptably high rate of recurrence and chronic morbidity. Doll *et al* (1965) estimated the total incidence of peptic ulceration in England and Wales in 1 449 000 patients with a period or past history of peptic ulcer.

If it is to be asked whether the present rate of avoiding the peptic ulceration is justified it might be wise also to ask what limits should be imposed upon medical treatment for recurrences and complications with a view to determining when surgery provides an acceptable alternative means of cure, hospital care and saving of manpower. It might be asked that the observation of Carl Marks and Sarnes (1955) that reduction of the parental oedema causes with the normal young peptic, implies a better operative result in the

older age group, but that is to take no account of the damaging effects of long standing duodenal ulceration which not merely affects the result of operation and the survival need is rightly to operate in an older age before the cancer (Lancet 1970) a cancer advocated by Marks and Lewis (1960) following a comparative review of peptic ulceration among the population of Britain.

It is a common stereotyped view that the older the age of onset, the worse the prognosis. Malinin, and Hartman (1949) certainly found no significant difference in the prognosis of peptic ulceration amongst various age groups in Sweden and in fact related prognosis directly to the duration of symptoms, a poor prognosis occurring in 68.8 per cent of patients with a history of over three years' duration and in 79 per cent of patients with a history of less than three years. There is as yet no proof that medical treatment alone effectively counter-acted as a remedy of early cases, with a few attacks who constitute the true medical group.

It is therefore concluded that there is a higher incidence of peptic ulceration in the Royal Navy than in a comparable civilian population in England and Wales. The incidence has been rising in the Royal Navy in a rate when it has been falling in civilian. The evidence is highest in voluntary groups (military medical and communications) and lowest in reserve groups (Royal Marines) and the technical branches where job satisfaction and activity are constant.

Including figures suggest that there may be a case for operating upon more patients particularly in the younger age group with good motivation.

Analgesic influences

The high incidence of peptic ulceration in women has been reported previously by Horn and Searson (1959) the Department

of Health for Scotland (1971) and several Scandinavian workers (Björk and Møller 1963, Nilsen 1965, and Schenker 1966).

Several influences appear to contribute to cause the high incidence: the prevalence of passive smoking and cheap cigarette patterns, at least and undoubtedly non-competitive and the changing character of current domestic status, aggravated by long periods of separation from home financial resources, the prevalence of group behaviour and the effects of foreign ports, artificial islands and environmental exposures, the mental demands of the new task settings and the physical demands of a tight routine in extreme climate conditions dictated by changes of equipment.

Alcohol

The women in a nationally representative and Wright (1961) compared the drinking habits of 102 naval ratings with those of 82 dockyard civilians. At the age of 25 79 per cent of naval ratings were drinking the traditional pint of 9th post of Imperial Stout daily and by the time they had reached the age of 40 92 per cent of them were doing so. There was some evidence that the daily use led to alcohol dependance (1961). By comparison there were no daily spirit drinkers and only 11 per cent of daily beer drinkers in the dockyard group. Walker (1968) considered alcohol a greater problem in the Navy than in other the Army or the Royal Air Force, chiefly because of its identity with the ingrained pattern of naval behaviour. Since the modern Navy requires alert, intelligent and highly trained technical personnel, it was obvious that the traditional rum ration was under criticism, finally removed in 1970. It is too early to say what the effects of this will be.

Smoking

Wright similarly compared the smoking habits of 102 civilians with those of 102

naval ratings and found that the largest percentage of ratings smoked between 10-15 cigarettes daily. By comparison the largest percentage of civilians smoked 10-15 cigarettes a day. The problem is aggravated in a nuclear submarine which may spend 3-5 months under the surface at the sea, the smoking adds greatly to the problems of atmosphere control. Indeed contaminants in the atmosphere may well lead to long term morbidity and already the Institute of Naval Medicine is finding significant changes in sensory thresholds (Group Lambert Morris, 1980). They may yet prove to be associated with changes in genetic stability.

Smoking and Health from the Report by the Royal College of Physicians of London (1970) finds a clear association between smoking and paper ulcer and stress ulcers. In the report Smoking and Health by the US Public Health Service (1964) concerning this, state: "While the report of the Royal College of Physicians fails to provide evidence that smoking is a direct cause of ulcers of the stomach and duodenum, it nevertheless provides adequate proof that smoking delays healing of established peptic ulcers and increases the risk of death from various complications such as haemorrhage or perforation. However, when the results of certain surveys are extrapolated to the Service situation, it must also be borne in mind that the average sailor smokes more cigarettes than his civilian counterpart. In a recent survey Walker (1968) stated the smoking habits of 900 naval personnel on the *For Est* Station and found that 73.4 per cent of non-medical ratings smoked and of these, over 10 per cent smoked between 10-15 cigarettes a day.

Many

The battle against stress is never ending whether it be on the flight deck or the deck lanes of a conventional submarine.

the upper limb (Fig. 1) and up to 100 gms. weight (Lundberg, 1955, 1956, 1957). Measurements made out by method of the Institute of Naval Medicine have revealed both mean levels (Klein, 1962, Table 1).

Some attempts have concerned with the introduction of Bioness and Phantom servos and a review survey conducted on board an aircraft carrier (K. Clark, 1956) revealed mean levels on the right side to be between 120 and 140 lb. very closely approaching a critical level for whole body exposure of 150 lb.

Post is a particular hazard for the soldier on board an aircraft carrier even in the cockpit, where he may be drawn to sleep on the upper deck. Fujano (to be published) has taken on board an aircraft carrier in August 1956 several upper limb areas with control tape levels of 70, 71, 100 lb. respectively (Rawlin, 1956).

Japan (1956) found that heavy workers exposed to strong noise developed postural reconstruction, disturbed cardiac rhythm disturbances of balance posture



Fig. 1. Upper limb area of concern. The subject is in the cockpit of an aircraft carrier, and the control panel is visible in the background.



logical habits and a propensity to these complained of governmental corruption. If as is apparent many of these effects are confined to some native and foreign may well be increased. In one case James reports that a number complained of starvation and malnutrition, to a certain length, which he also attributed to native habits.

The policy of providing window shops with control rooms will eventually eliminate the cause of some hazard and the beneficial effect of a control room is demonstrated in Fig. 10 by measurements made by the staff of the Institute of Naval Medicine.

1111

Apart from the obvious evidence of heat and cold to which nasal mucus and Mucosal Membrane are continuously exposed, microorganisms have been readily cultured



Fig. 10. *Macromastix* sp. on *Paratub. 14*, showing
only one of the spines. (a) 100 \times , (b) 200 \times .

in extremes of heat and humidity or other factors such as the exposure and body areas which cause prolonged electrolytic imbalance and possibly, changes in the balance mechanism of the body.

Thus there is the sense of responsibility, and Fig. 2 shows that, when demand is

100

Windows® (x64) or Linux	100% for 100% of the 1000 studies, 10-100% for a few "specialty" ones (200-20%)
Windows® (from a long perspective)	10-100% for 100% of the 1000 studies and their dependent variables
Eng or Russ Internet (x64)	10-100% statements
Eng or Russ Internet)	100-100% statements
Other Russ	10-100% statements
Language: Russ	100-100% statements
Abstract (Russ, Russ, etc)	Up to 100% for a few specialty abstracts (abstracts, not up to 100% statements, not all the data, mostly Russ). 100% on all the data while abstracts change and security.
References (x64)	Up to 100% for 1-2 statements
References (p Russ)	Up to 100% for 1-2 or more
Abstract (Russ, Russ, Russ)	Up to 100% statements plus other full texts (100% on all, all)
English, Russ, Russ	Up to 100% statements plus other full texts
References - Russ, Russ, Russ	Up to 100% statements plus other full texts
References - other Russ, etc.	Up to 100% statements plus other full texts
Abstract (Russ, Russ, Russ)	Up to 100% on other full

of the young, white group: those who develop peptic ulcer appear to break down when they reach Chief Petty Officer status and it is at this stage that the reticent teacher has their highest incidence more so in the Chiefs who bear the full responsibility spent long hours in workshops endeavouring to maintain sophisticated electronic equipment or keep complex modern air craft in the air. However it is difficult to repeat the onset of peptic ulceration with the degree of responsibility alone except efforts with the lowest incidence of peptic ulcer also had heavy responsibilities. Deriving a Peters substance put up up standards from some 10000 people engaged in every household to land on the deck of an aircraft carrier at night, co-ordinating ship/shore communications in a command operation or manoeuvres required a high degree of skill, judgment and concentration were all part of the modern sailor's life during the period under review.

It may be of significance that the British campaign and troubles in Aden were a feature of the year 1965 onwards and that the incidence of peptic ulceration for the last five years, of the survey rose from 201 to 261 per 10 000 population at a time when the incidence in England and Wales generally was falling (Fig. 3).

Domestic Stress

Domestic stress is a major problem. The long separation anxiety about homes and their purchase problems and the personal attraction of a run where all play their part. Wallis (1955) in his article 'Retirement for the Midlery' draws attention to the work of Ellis (1946) who showed that nervous and cerebral changes have brought the commonest cause of disability from the Navy. Wallis also points out that psychological factors were found to be responsible for many of these accidents. He emphasized the effect of broken

homes and especially step-obligings upon the psychomotor breakdown in the British Forces homes, and domestic mishaps have often been the background to our surgical cases in the Royal Naval Hospital, Haslar. Many sailors join the Navy to escape an unsatisfactory home life and in the choice of a life partner often do little better themselves.

Waller's graphs of the percentage incidence of the annual strength of the Royal Navy and Royal Marines for the years 1953-1969 show a significant rise in readmissions for ulcers between 1963 and 1968 in both groups and this appears to correlate well with our own findings of an increased incidence of peptic ulceration between 1964 and 1968.

Maritime Stressors

The only common factor would appear to be the stress of the British and Aden campaigns and the build up of the Far East Fleet causing increasing difficulties that resulted in the introduction of temporary working standards in 1963 which meant in effect, that lower stress ratings carried out more often. The latter would therefore appear to be obvious. Man cannot be pushed beyond his physical and mental limitations, particularly in an adverse environment and climate. Since in Wolf and Wolf (1945) demonstrated in their gastroscopy papers, Toml, the gastric mucosa faithfully reflects an individual's tension and emotion, a susceptible patient will break down under these conditions.

The reports of Thompson, Hunt and Jamieson (1954) and Tidy (1947) do a great injustice to the incidence of peptic ulcer peptic ulcer occurred during the London Blitz of World War II might appear to lend support to the hypothesis but, as Oliver, Campbell and Francis (1968) point out, this was not in striking contrast to the effect of American bombing of Japan.

in 1945. All cases of paper rationing were soon among some 6,000 official provisions of war in Tokyo and only one case amongst 1,000-4,000 provisions in Rangoon and Cebu in one year. Palmer (1974), in his admirable review of the incidence and consequences of these drastic quotas, Bookbinder is asking that World War II brought an increase in the incidence of paper rationing in Great Britain. Wolf (1954) draws the wrong conclusion, however, that in countries the deterioration in Dutch paper ration patterns was improved when they became prisoners of war in Germany in the worst problems and incentives caused by reacting to their localized but clearly changed in capacities of the above situation could not be expected to produce dramatically opposite results.

Diet

General and Food Consumption

The period under review was marked by radical changes in eating arrangements on board HMS ships and establishments which resulted in the introduction of general rationing ships (albeit with multi-chef work and, in consequence, changes in the consumption per unit of the principal foods). In addition, the training and status of naval cooks improved and very high standards of catering were achieved in the latter half of the period. Because of the large number of variables, no reliable estimates are available from which to deduce meaningful results. For instance, only isolated observations are available on percentage increases or decreases in some foods for the period 1955-64 which gave no indication of the consumption per man 60 let as they go, they appear to show no change in sugar consumption (apart from confectionery) and a decreased consumption of bread and flour offset by increases in such items as potatoes, baked beans and rice.

Trends in the general population during

this period were different. There was a similar reduction in wheat flour consumption but also potatoes. Consumption of other cereals remained unchanged and sugar consumption steadily rose (Kilmer, McKenna and Yule, 1960). To get a true picture of sugar consumption in the Navy, however, it is necessary to look at the consumption of confectionery and chocolate which is not reflected in the Veterinary figures and not fully recorded in Health statistics.

Chocolate and Confectionery

It has proved equally difficult to obtain any accurate figures covering the overall consumption of chocolate and confectionery and different estimates have been received from different sources for the same establishment. Some information is available regarding the consumption of confectionery and especially in HMS GANGES the boys' training establishment for the period 1955-1964. No changes in the type of confectionery occurred during that period and the age of entry remained 15-16 throughout.

Table III compares the amount spent per boy on confectionery and especially for the years 1959-1964. Prices of chocolate and confectionery were 6d and 7d in 1959 rising to 6d and 9d in 1964 when over half the amount sold at 6d. A packet of cigarettes costing 3/11d in 1959 rose to 6/4 in 1964. When adjustments have been made for changes in price it would appear that the actual consumption per boy of confectionery dropped by around 60 percent from 1960 and that 200 fewer cigarettes were being smoked. There are a number of fallacies in these figures, for they take no account of the amount spent on these items before war the amount spent by different individuals. However, the introduction of rationing methods in HMS GANGES in 1971 showed that bread and consumption of confectionery

TABLE II
Confederatory and cigarette consumption in 1976: Glasgow, Boys' Training Establishment

Age	Height	Cigarette and paper consumption		Cigarettes	
		Years' Total	Per Man	Years' Total	Per Man
15/16	1 000	143 543	144	17 028	87
16	1 200	16 590	17 10	18 075	91
17	1 500	17 154	17 10	18 622	94
18	1 700	20 008	17 5	18 760	96
19	1 900	20 199	17 5	18 867	97
20	2 000	26 140	26 14	20 000	99
21	1 700	22 091	21 09	17 368	94
22	1 700	22 190	22 19	18 029	97
23	1 900	26 000	26 0	20 000	99
24	1 900	26 000	26 0	20 000	99

TABLE III

Cigarette consumption in various subgroups during representative periods 1976

Period	Average Consumption per man/day (1976/1977)	Average Consumption per man/week (1976/1977)
A	2.51	17.57
B	1.82	12.74
C	2.16	15.24
D	2.19	15.33
E	2.51	17.57

measured. The under report in the rate of cigarette use was probably false, because heavy smoking only begins when ship-borne cigarettes are available and many who have never smoked commence smoking at that time under the influence of both group pressure and the belief that to refuse would be to slip out of an environment that has become so important a part of the sailor's life.

A more accurate indication of the extent of curren consumption at sea has been supplied by Fournet (1971) and Table III is a record of the consumption per man per day and per week during a representative number of sailing subgroups (periods of varying length). Consumption of one biscuit per day seems to be a minimum for heavy smokers probably versus with minimums on smoking, but the lowest figure of 12.74

or a week is 1.5 times the national average (10) and the highest figure is three times the national average!

Age, Height, Weight Relationships

It is to be expected that changes in eating and drinking habits should be reflected in age-height-weight relationships and as a recent analysis of three pure males in 1974 naval personnel Minkley (1976), 1976b) showed that linear story at the age of 15 to the age of 17 the mature naval rating has the same weight for height as the 17 year old of twenty years ago when the handbook of Naval Medical Research—BR/150 (1950) was published. At 23 years of age he is 14% heavier than his 19-year-old predecessor of comparable height who only smoked ten

weight, at the age 15-20. This weight for height difference, is maintained through out life and Mackay concluded that it was due largely to an increase in adipose tissue. Mackay showed good correlation between BMI750 standards and Metropolitan Life Insurance Company data for men aged 30-34 and the greater weight for the same height and age of the modern naval rating.

The Boatswain's Dinner

Claver has related the incidence of pipe, steamer, tea diet and tenders, to a modification of the Boatswain's Dinner responsible for other conditions also common among naval personnel such as obesity, haemorrhoids and varicose veins. In his various publications Claver (1936, 1940, 1942, 1971) and Claver *et al* (1969) has marshalled an impressive array of evidence which, in summary, lays the blame at the door of the refined carbohydrates of naval era rations and potential vice of the other side of India. He considers that removal of the protein component of carbohydrate foods and loss of bulk fibre results in a reduction of buffering power which allows unbuffered acid to buffer the bloodstream during the post prandial period. The concentration of carbohydrate leads to over consumption and obesity. Claver draws attention to the rise in sugar consumption in the United Kingdom from 1½ lb per head in 1815 to 12½ lb per head in 1945. By 1945 a food reached 850 g per head and pipe steamer begins to appear about the turn of the century. He evokes the role of Leonard Jones Fletcher and Mann (1943) who showed a sugar rise and higher mean protein level, in six detailed ship profiles other meals of refined meats than other meals of whole meats and intake, consistently

which metastasized into blood glucose and eventually precipitated diabetes and the modern medical party line. For the same reason he would no doubt condemn the sailor's own actions although there is an example of other factors under these circumstances. For instance protein was elevated in response to alcohol, stimulation is elicited by the large quantity of beer consumed in a relatively short time but the advantage is probably offset by the continuing stimulus to gastric and secretory caused by diabetes and vasodilation of the stomach.

Claver *et al* (1969) find a direct relation ship between the geographical incidence of pipe, steamer and the quantity of refined carbohydrates consumed in Africa, India, Indonesia, Malaya and Japan. They point out that although the negro steamer line from pipe, steamer in Africa, whilst eating unrefined carbohydrate, still in Northern Nigeria, yet he develops typical pipe steamer when refined carbohydrate is introduced *etc.* in Southern Nigeria, while the incidence of pipe steamer is so common amongst negroes in amongst white soldiers in the United States, Army, (Kawthorpe 1960), Palmer (1970) reporting a personal study of 1,500 American prisoners from Japanese prisoner of war camps following the conclusion of World War II are unable to account for the apparent paradox that men with a history of pipe steamer prior to capture had no symptoms while living on non-refined rations but immediately developed very few diabetes upon repatriation to states, in the paper of White (1944) who showed that 12 per cent of 200 German prisoners held in the United States of America developed pronounced diabetes after on the abundance diet with which they were supplied.

Claver attributes all these apparent anomalies to the proportions of refined carbohydrate in the diet and notes that

*"Excessive pronounced like the river Rhine, is dominated it from the chemical manure"

although 44 per cent of prisoners of war died whilst working on the Burma railway the rest they contracted was either untreated or supplemented with rice bran and poppy oilseeds was almost never seen. He quotes the observations of John Taylor (1931) that dandruff ulcer had been so frequent to long in non-piliferous countries to be treated with the highly refined rice supplied to allied prisoners of war in Singapore and Thailand but that in such dandruff poppy oilseeds became a plague.

In view of the evidence of the high consumption of refined carbohydrates throughout the Royal Navy it would be difficult to avoid the conclusion that there is a direct relationship between diet, overweight and the high incidence of poppy skin lesions.

Intestinal Parasites

Sailors and Royal Marines in their worldwide travels are particularly exposed to intestinal infections which cause dyspeptic symptoms previously attributed to gastritis or dandruff and accounting for the high figure of non-ulcer dyspepsia at the beginning of the period under review. The more general recognition of the role of intestinal microflora in dyspepsia and the earlier diagnosis and treatment of the condition account largely for the sharp fall towards the end of this period. Prentice (1964) found 51 per cent of 40 volunteers from 41 Commands Royal Marines with intestinal parasites in their stools on returning from the Far East and another one were found in 34 per cent of volunteers in a cruiser in the East Indies. In a later study Prentice (1976) showed that a significantly greater maximum histamine response in patients with dandruff ulcer than those with functional dyspepsia was corroborated by patients with gastritis and the gastric response of all came from those patients with a dandruff ulcer and gastritis combined.

Dave Haythorn and Kenneth Ollivier reported their findings in 120 patients with upper gastrointestinal symptoms in whom *Candida* infection was isolated on viral examinations. Dandruff deformity was present on X-ray and 93 patients became symptom-free 10 days after treatment with chloroquine the remainder requiring a third course of chloroquine before symptoms disappeared. Dandruff deformity cleared up approximately two months after treatment.

Formerly upper intestinal parasites cause the irritant of intestinal gastritis responsible for prolonged high gastric acid output and antral, with normal duodenal inhibitory responses. Prolonged intestinal gastritis ulcers have been shown to be associated with intestinal stasis and depression following vagotomy (Kelly, Nelson and Hartley, 1964; Madsen, Kelly, Nelson and Hartley, 1967).

Ship Habitability and Air-Conditioning

It has proved difficult to obtain accurate figures regarding the introduction of air-conditioning in the Fleet which stemmed from the setting up of an Air-Conditioning Panel in July 1944 and was followed by the Warship Habitability Panel of the Royal Naval Personnel Research Committee created in July 1948. Records of air-conditioning in ships of the Far East Fleet are inadequate before 1960, but prior air-conditioning was introduced into some ships, namely in living and working spaces between 1938 and 1944. In 1960 the policy of introducing full air-conditioning into future ships was promulgated but, in 1963, ships continued to arrive on the Far East Station with little or no air-conditioning and observation was made upon the considerable effect this had upon the material efficiency of such ships and the physical fitness and morale of their officers and ratings.

Newcastle: Blackstock (1968) con-

namely upon the pattern of ventilation in the Royal Navy observed that the high incidence of ventilation in engine room personnel declined steadily from 1935 to 1964. He considered that, away from hot lines, no essential change in the temperature of engine and boiler room spaces, the decline probably represented the effect of the increasing use of air-conditioning in more comfortable engine rooms where work had not been a problem and which were normally occupied by engine room personnel.

It is also pertinent that the incidence of ventilation was 23 per thousand in a Mediterranean climate and 17 per thousand in tropical conditions (Blacklock, 1964). His highest incidence was among oilfield clerks and supply personnel at ports engaged in intermediate positions and his lowest incidence was among Royal Marines and seamen (Fig. 11). He also noted the distribution to be related to physical activity: the incidence of work during leavey hours in voluntary groups and lowest in active groups. The upper end findings of this survey however, was that he found no evidence of person-patient attendance at 7 per cent, vary in nature of the incidence of patient attendance to the Royal Navy as a whole. It is perhaps noteworthy that over 300 of his 524 cases were overweights.

The rapid increase in the number of naval personnel serving in air-conditioned ships after 1968 occurred in a time when

the incidence of patient attendance in the Navy as a whole was rising. It is clear therefore that whatever the relationship between ventilation and patient attendance, climate factors have little to do with it.

General Aerial Incidence

The period under review was dominated by an intense preoccupation with patient and seaman attempts to separate maximal and output to determine its relevance to disease states and to assess the significance of preoperative values in regard to the adequacy of treatment or vagotomy procedures. The publication of data from different laboratories revealed sources of error in both sample collection and laboratory estimation. The period was characterized by modification of standard tests and the introduction of new tests of gastric function less emphasized by the patient and more accurate in terms of reproducibility and laboratory clear limitations.

Although Woodward, Harper, Toner and Dringstedt (1965) records the nervous phase of patient reaction to play a dominant role in decisions about gastric resections and Ray (1966) found that 50 per cent of 56 patients appeared to have actual discomfort when the studies of their studies were examined. The danger of using preoperative gastric function studies as a means of proposing the type of surgery and predicting its results is underlined by Luvag and Hargy (1966). They conclude that acid secretion seems not to be the only determinant factor in the pre-decision of gastric functional status and accordingly acid secretion should not be over emphasized in determining the type gastric surgical procedure.

Predictive Role of Acid Secretory Studies

The efficacy of predicting the results of vagotomy has been shown by the pre-operative maximal vagotony test of Old



Fig. 11 Incidence of ventilation in the Royal Navy according to service (Blacklock, 1964).

longer and Kay (1964) which indicates vagal blockade by the autonomic response of 5 mg hexamethonium bromide and 0.025 mg of atropine. Johnson, Gough and Butler (1966) certainly found statistically significant correlation between the test output after medical and surgical vagotomy when the pre- and postoperative results were compared in groups, but found the degree of vagal block by medical vagotomy appeared to vary in individual and this is judged by the similar hypoglycaemia test and they concluded that postoperative medical vagotomy had poor predictive value for the individual.

Seems and Small (1964) also found the standard procedure, whether treatment or vagotomy and drainage when performed on patients with similar preoperative medical and output produced no predictable differences in the degree of reduction of postoperative acid output. They showed that acid output correlated so proportion to the duration of the duodenal ulcer subjects both in ulcer history of under 12 months having a normal output and suggested that the duodenal acid output was secondary to lesions of the proximal duodenum causing distension of the antrum gastric release and increasing acid production.

Such duodenal lesions must affect not inhibitory mechanisms mediated via the damaged duodenal receptors and Duggan and Woodward (1963) have pointed out the hypersecretion which results when the normal duodenal brake on gastric acid secretion is prevented from operating. Johnson and Butler (1966) showed duodenal inhibitory response to an infusion of 0.10 hydrochloric acid into the proximal duodenum of duodenal ulcer patients and there is therefore evidence to suggest that the higher acid secretion in duodenal ulcer patients is the result of a damaged duodenum rather than a genetically determined difference in the parietal

cell mass.

From the available evidence it appears probable that a basal secretion over 4 mEq HCl per hour and a maximal secretion of over 24 mEq per hour increases the likelihood of an associated duodenal ulcer in male subjects.

Gastric Inversion Studies in Duodenal Patients

The Augmented Heilmann Test (Kay 1951) was the standard prospective test of gastric secretory function in the earlier part of the period. The acid concentration was determined by volumetric titration with 0.1N NaOH to endpoint neutralization around pH 7. When the Department of Surgery in Herby changed its own department laboratory the Pentagastrin Test (Pentagastrin Food Study 1967) replaced the Augmented Heilmann Test as the standard procedure using a modified gastric radiological method as gastric pump and electronic titration (Radioactive TTT) (Fig. 17).

Results of Prospective Augmented Heilmann Test in Male Duodenal Patients With Duodenal Ulcer

Figure 18 is the prospective secretory profile of 129 male duodenal ulcer patients from the early years of this study and shows the basal hour and hexamethonium-stimulated maximal acid response in ml



Fig. 18. Prospective secretory profile of 129 male duodenal ulcer patients.

differences in the lower α ($P < 0.05$) but is in highly significant at the 1 per cent level. The 400 mHz battery unit, stress and workload demands have a positive main, however quite subject to bias, bias made by high sleep. A two-tailed test applied to test the significance of the difference between the mean and standard deviation. If the time taken for gastric acid to be maximal (secretion group) the difference in the standard deviation was tested for the various (400 mHz) unit and the observed difference in the mean by the statistic t test. The difference between the standard deviation is fairly significant at the 1 per cent level and the observed difference in mean is not significant. Applying the statistic t test to post stress and postoperative and comparing the observed difference in the mean between (stress and post-operative) unit is not statistically significant.

Acid and Stress

The higher gastric acid output of naval personnel with decreased sleep or response both to the segmented batteries and postoperative tests compares with the results of such tests reported in civilian cases. Only the highest levels probably represent damage to gastric voluntary mechanisms rather than the response of such persons to stress. Prospective and studies have no predictive value and only appear useful as a basis for determining the percentage reduction in acid secretory capacity following operations.

The low incidence of gastric disturbance amongst Royal Marines and the high incidence amongst voluntary groups does appear to raise the question of whether stress and workload is the important or dominant in gastric ulceration or is believed to be or whether gastric emptying and gastrointestinal motility plays a more important part. Royal Marines are exposed to the maximal situation which very often causes the highest acid response of any group yet they have the lowest incidence of gastric ulceration or signs of similar environmental distress. It might be asked whether their low incidence of ulceration is also purely environmental or whether physical fitness and training play an important role both in endogenous and gastrointestinal dynamics. How do they

effect gastric gastric emptying and distension and motility and the complex system of gastric secretion? The gastric voluntary mechanisms and the gastric function stress and pain in the duodenum and are peak and response being, by gastric motion, be a variety of response or response individuals. For instance, concentrations among who comprise a large section of the Civilian group spend most of their work slumped over a table or peering at a screen.

Other Environmental Factors

The effects of other potential hazards have not yet been evaluated. What for instance, is the influence of the electrical fields in which the men? living spends most of his life upon the human brain? How do waves from the battery of electronic equipment in modern warships influence the hypothalamus? Hall and Smith (1966) have shown by accurately placed electrodes in primate brains correlated with histological studies, that chronic electrical stimulation of the anterior hypothalamus (hypothalamus) causes decreased acid output if a substantial lesion is present. Because they found a time lag they postulated neurochemical control involving central pattern.

It is perhaps not really surprising that the incidence of gastric ulceration is high in the Royal Navy and further research is required to establish more precisely the aetiological factors involved.

Aetiological Influences

General Discussion and Conclusions

In attempting to draw legitimate conclusions from the mass of information concerning the diverse aetiological influences to which the modern sailor is exposed it has seemed important to avoid conjecture and to attempt rather to correlate features of significance.

For instance, there appears to be a direct relationship between the rise in the number of suicides in both Royal Navy sailors and Royal Marine other ranks following the outbreak of war in Europe, introduction of overseas stations in Asia and introduction of emergency training standards in 1903 which in effect meant that manpower resources were overstrained. The implications of this problem were widely recognized by the then Minister of Defense, Mr. Christopher Mayhew (1966) who referred to the basic mistake of giving the Armed Forces too large tasks and too few resources.

This appears to be reflected in the rise in incidence of postwar peptic ulcers from 30.4 per 10,000 for the years 1949-1953 to 39.1 per 10,000 for the years 1964-1968. The figures are increasing in spite of a recent statement in the House of Commons by Mr. Peter Rook Under Secretary of State for Defense in the Defense Debate (1971). There has been much talk recently about manpower shortages and the inability to meet commitments with the consequent strain on both ships and personnel. I would not pretend that we have all the resources we need. That is no new factor. There is some degree of understatement in the Navy as in the other Services and the increasing time for deployment and deployment has steadily increased at recent years from 19,000 miles per year per ship in 1925 to 30,000 miles in 1970.

Thus stress may play a part in increased by the results of several surveys. Doll, Jakes and Burkhardt (1931) found a high incidence of duodenal ulcer in men holding responsible positions whether business or business executives who expressed anxiety over their work. Murray (1970) in a survey of peptic ulceration in a university population of some 11,576 students, adults and young men who might be expected to suffer from stress appeared to find an incidence of peptic peptic ulcer in

the region of 70 per 10,000 which approaches the lowest level incidence and is much higher than for this age group in the general population. Dringstedt (1956) and Heymans and Wansberg (1959) have attempted to show that stress causes an increase in acid secretion.

However, Armstrong, Ransing, Jacobson, Kake, Ward and Golden (1963) established a relationship between high stress rates and peptic activity in duodenal ulcer patients, but not in normal controls by measuring secreted mucous rates monitored by CEC, EMO and eye movement recordings on the basis of the work of Dumas and Kleiman (1957) who related eye movement patterns (REMOR) are related to duodenal. Figures 16 and 17 show the results and several increased secretion rates.



Fig. 16. Duodenal acid secretion in 100 ml of gastric juice after stress (Armstrong et al. 1963).



Fig. 17. Duodenal acid secretion in 100 ml of gastric juice after stress (Armstrong et al. 1963).

in diabetic patients have normal control, who lack or demonstrate any consistent alteration in sodium ions.

Such findings demonstrate the influence of the psyche upon gastric acid secretion, but only in the peptic ulcer patients. They do not, in any way, relate high secretion rates to the incidence of peptic ulcerance and have little predictive significance. They may represent either the susceptibility of the ulcer prone patient to psychical stimuli or alternatively may merely indicate the failure of local physiological mechanisms to adjust acid secretion after stimulation and thence have developed receptor mechanisms, as shown by Johnson and Dukes (1964).

There is also considerable evidence that upper intestinal patients cause high acid levels, and Freyhan has demonstrated very high acid outputs in response to the ingestion of histamine and in both Royal Marines and naval ratings, with great care. His studies would appear to suggest that provided the normal neuro-humoral and buffering mechanisms are intact high acid outputs are not necessarily associated with an increased risk of peptic ulcerance. This observation has to be correlated with the finding of a lower incidence of peptic ulcer in the Royal Marine group as a whole considering that Royal Marines are exposed to much greater risks of intestinal infection and therefore can be exposed to fairly proportionately higher acid secretion rates than sailors. It is also of significance that Blacklock found a low incidence of ulceratives amongst Royal Marines though exposed to similar other risk factors and often under water deprivation while showing a high incidence in sedentary groups.

The incidence of peptic ulcer among his class of individuals was most interesting since that in the naval population generally and it does appear to suggest that physical fitness and activity by influencing

both endogenous and exogenous factors may play a dominant role in both conditions. As it has already been noted that active workers on the land had a low incidence of peptic ulcer in the survey carried out by Hall *et al* (1962).

Blacklock also found a high proportion of his patients overweight and it is of interest that soldiers training enables the Royal Marines to conform to weight/height age standards while as Mackay has shown after the age of 25 the average naval rating is not above heavier than his counterpart of 20 years ago. It is also of significance that high acid gastric rates in training establishments who are trained to high standards of physical fitness and undergo an exceptionally strict spirit that after training is completed do not develop peptic ulceration in significant numbers and they have such establishments but of course neither are they prey to heavy smoking and alcoholic excess.

Mackay's findings seem to support Claver's concept in *The Bushfire Doctor* in which in the incidence of peptic ulcerance and his assertion that the incidence of peptic ulcer parallels the release of sugar and carbohydrates which because they are less bulky tend to easily leading to over consumption and obesity. Claver's view appears more logical than that of Palmer (1970) who seeks an explanation of the apparent paradox that the peptic ulcer patients who had remained symptom-free through the semi starvation conditions of Japanese prisoner of war camps developed fatal recrudescence on return to a liberal American diet following repatriation. Palmer speculates wrongly that the development of peptic ulceration in the American negro provides a parallel warning in the emotional impact felt when the white slaveholder life of a slave suddenly gave way to a hard freedom wholly unprepared for with rapidly increasing personal and social responsibility

largely unprepared for. Clavin's hypothesis makes more sense.

Clavin reports, more and considers detailed factors all important. Certainly there is evidence that consumption of refined carbohydrates per man in the form of confectionery is much higher in the Navy than in the population generally. It also appears probable that refined carbohydrate consumption increases as a result of changes in fleet training, maintenance, welfare systems and greater needs by naval vessels in the provision of food and particularly sweets. Whether such changes can be regarded as improvements in terms of physical fitness, when they can be shown to be associated with obesity, peptic ulceration and arthralgia is an other matter and other consequences of obesity are well recognized. It is not with out significance that the consumption of cigarettes and confectionery in 14000 CANADIAN air force entry training recruits more declined during the period and that from entry at 15 up to 17 years of age the recruits rising has the same weight/height/age ratio as 1950.

Clavin is also of interest in relation to the high consumption of tobacco in the older sailors. The Munro (1970) found that at the age of 71 his Massachusetts physicians took detailed notes had the same height, weight and ponderal index (weight/height³) as non-smoking smokers at the age of 71 but they were more obese as they grew older. The higher build of cigarette smokers has been confirmed by several workers (Royal College of Physicians Report, 1971) and the association between the acquisition of obesity with high cigarette consumption amongst older naval personnel more points to the high carbohydrate consumption and lack of exercise.

The high carbohydrate consumption is supported by a high consumption of alcohol which White (1946) attributes to 'the personality of the stimulus associated

with alcohol and his motives for going to sea, such as escape from home, responsibility and stress and enduring continental sea and the desire for excitement and change and 'socially environment factors, among which are the very availability of alcohol in ships, continued crowded navy, and last living conditions, boredom and lack of exercise at sea and the officers' need to ally the emotional tension which he has encountered during the voyage in ports where the recreational facilities other than those associated with drinking are minimal.

Such evidence to the personality of the sailor has been frequent throughout history and Thomas Young (1781) and Agass Weston (1915) noted it from quite different viewpoints in similar terms. It is therefore of note that Munro (1970) suggests that both alcohol and heavy cigarette smoking had their origin in the personality of the individual who is more nervous or emotional than the normal. Given this personality it might be expected that earlier marriage release from of regulations which now permit the single sailor to live alone and consequent changes in visiting arrangements which may reflect his opportunities for regular well-ordered meals will do little to reduce the incidence of peptic ulcer in the future.

Environmental factors per se appear to have made no direct contribution to the incidence of peptic ulcer but if stress is a factor the increasing stresses work, land mine tests and commitment of sophisticated electronic equipment before dock or unavailability in and sustained war partners and the frustration of at times increase under adverse conditions is certainly contributory but the lower incidence of peptic ulcer in the industrial 'family' exposed to maximum stress situations may indicate that job satisfaction is the overriding consideration and should also re-duce the influence of these particularly

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THE MEDICAL CADET SCHEME IN THE ROYAL NAVY

By Michael Korman

With the ending of National Service in 1963 it became clear that a serious shortage of doctors would soon affect the three Services. Accordingly the Medical Services Co-ordinating Committee set out to examine the problem and its report issued on January 28, 1963, made a number of recommendations, mainly on extension of the Kitchener Scholarship scheme and the introduction of medical cadetships.

These proposals received support on all sides, and after a considerably short struggle about rates of pay and guarantees along with some other minor details, the scheme was announced in the House of the Minister of Defence on April 18, 1962. It has remained essentially unchanged and operates in all three Services.

What the Scheme is

Medical Cadets may become naval medical cadets at any time after passing second MB or its equivalent. In many instances the second MB, as it used to be called, has recently disappeared and it is now perhaps more accurate to say that cadetship covers the 3 best clinical years of the medical course. Cadets enter as Surgeon Sub-Lieutenants on full pay and allowances, have accommodation and meals free paid and an allowance for books. On qualification they are promoted to Acting Surgeon Lieutenant for their prerogative pay rate and then start a 3 year Short Service commitment in the rank of Surgeon Lieutenant, at the end of which, if they leave the Service, they receive a service gratuity, its amount depending upon how long they have spent in cadets.

If they decide to remain in the Service for a longer period, they may extend their Short Service Commitment and so when a longer guarantee apply for a 14 year post-qualifying commitment or to join the Permanent List. In each case, they will be promoted to Surgeon Lieutenant Commander.

Those who apply for a 14 year commitment on the Permanent List can count all service after the age of 31 years towards it, so that a doctor who has spent three years as a cadet, one year on post-qualification appointments and five years as a Short Service commitment has only to serve a further seven years before completing the 14 years which entitles a pension for the rest of his life, presently about £1,000 per annum. He also gets three times this amount as a terminal gratuity. Assuming that he survives for his three-career years and his three additional stress years, will have paid him pretty well.

How to Recruit

Like most other organisations we of course use an advertising is handled by an agency which also looks after all other branches of the Navy. After discussion with MDCN's the agency produces the type two spots in appropriate public news and keeps a running check on the results. As planned advertisements go into the British Medical Journal, Current Practitioner and Medical Medicine, which account for three fifths of our paid advertising appointments. In addition we advertise in some 25 medical school journals.

Every day of the year we see a similar situation confronted by 12 students who are meeting the end of preclinical training. This lasts a month and is designed to give an initial exposure of the Navy as possible. Students visit all types of naval establishments, live in naval accommodation, get at least a day in the real three weeks at the Navy Force for a week, and do anything else we can arrange for them. No payment of any kind is put upon them to join the Navy, but these courses have proved their worth in showing what we have to offer, since a proportion of those attending always apply for cadetship subsequently.

When possible, meetings between visiting officers and cadets are arranged in London. Ideally they ought to be arranged elsewhere, but this is impracticable unless the number of cadets in each area is so small. The meetings are quite informal and provide an opportunity for cadets from different medical schools to meet each other and also to discuss any problems with the staff of the Medical Director General. It is hoped to arrange more meetings of this nature.

Occasionally, but not by any means often enough, cadets are allowed to speak at student association meetings and similar gatherings to raised careers fees and other student problems. Such opportunities for direct contact with students are of great value and though the meetings are not directly concerned with recruiting they provide a chance to answer questions about service at the Navy at some stage in the proceedings and to clear up a few misconceptions. There are still widespread for instance a mistaken idea that all senior medical officers are exclusively engaged in administrative duties.

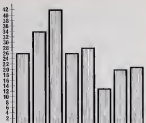
How we Select

Enquiries often as to MEDMS really

as a result of the general advertisement, sometimes through personal contact with a university liaison officer. Enquiries to visit the relevant literature and an invitation to discuss careers further. A proportion of them fit in formal appointments and then attend an interview board at RN Hospital, London, consisting of one of the Medical Director General's staff officers in Charge of the Director of Naval Medical Staff Training, a senior civil servant from Naval Personnel Services and a civilian consultant to the Navy and an interview officer, usually from the Admiralty Interview Board. Each candidate is interviewed for about 30 minutes over a wide ranging field and the Board studies his references, one of which comes from the clerk of his medical school. An assessment is made of his motivation and academic ability and whether he would be likely to fit the naval environment. About 50 per cent of those who attend the Board are eventually accepted as cadets, and this figure has remained fairly constant over the years (Fig. 2).

What Cadets do

It is obviously important that a student's career should suffer minimal interruption if he becomes a cadet. For this reason the only demand made upon him is that he should attend the two-week naval preparatory course at Royal Naval Hospital, Portsmouth. He has no other training commitment whatever and as in all respects needed no any other medical student except that he is considerably active! However busy cadets are in the leisure periods with the Navy leaving from one to three months and making their contact with the Service thereby. These periods are usually spent abroad or at the Institute of Naval Medicine and we have even sent cadets to the island at Singapore (Figs. 2 and 3). It would be useful if all cadets could spend more time in a naval environment.



Financial Year 1962/3 1964/5 1965/6 1966/7 1967/8 1968/9 1969/70 1970/1

Fig. 1. Number of students present.



Fig. 1. Student, 2, 1965/6, 1966/7.



Fig. 2. Student, 1966/7, 1967/8, 1968/9.

but it has been said to be impracticable in view of the contrary principle of such training and the discipline of most medical schools.

Results in Practice

Medical studentships were private over 90 per cent of all doctors entering the Service so that it is true to say that medical manpower depends upon them. Figure 1 shows the numbers of cadets entered in each year since 1946 and it will be noted that the numbers were higher in the earlier years than they are now. This is because usually no restriction was placed on numbers and large numbers applied and were accepted. In 1946 however the authorized number was reduced to 10 per year with a consequent falling of interest. In 1948 agreement was reached that the annual intake should be restricted to 25 and numbers are now increasing again. It might have been tempting to overcome the shortage by accepting a large number of applicants, but the letters applied by the selection board have been maintained and only suitable qualified candidates likely to succeed and be happy in a Service environment have been offered cadships.

It is also interesting to compare cadet entry from the various medical schools (Fig. 4). This policy has always been to try to select as wide a geographic spread as possible but the large number of medical schools in the London area inevitably gave this region a great preponderance. The large number of cadets coming from Barts and the fact that the last two men joined of the three have been Barts men is purely coincidental.

The earlier holders of cadships are now reaching the end of their 3 year Short Service commissions and apart from those who have been awarded or allowed to re-join permanently 28 have now left the Navy. It is time to look at the number



Fig. 4. Number of cadets entered in medical school from 1946.

who apply for Permanent Commission so some exact data figures are a part of the ultimate success of the scheme. So far 9 ex-cadets have applied either for 10 years or Permanent List commissions and a further 8 have extended their original 3 year Short Service commissions usually by two years.

The Future

The present complement for the Medical Branch in the years ahead has not yet been determined but it seems clear that on the more conservative estimate we shall be considerably undermanned. It is, of course possible that there will be a marked increase in the number of direct entrants but although numbers are going up it would be foolish to depend upon it. What is needed is a further improvement in the number of graduates already serving who apply for Permanent List commissions for it is obviously better to encourage those already in the Service to stay than to attempt to recruit a large number of direct entrants. The trend in this respect is improving but the numbers are by no means large enough to show any compensatory.

What can be done? Various estimates of the present scheme are being considered including one which offers to 8 year

Short service commences with a greatly enhanced financial gratuity, but this will only go part of the way towards solving the problem, although it will provide valuable financial support in both annual day and special pay. Talking to cadets makes it clear that they would like more contact with the Navy during their cadet years. Making sure they are just like other medical students may be popular with their friends, but it is not popular with the cadets. At this stage they want to identify with the Navy, to be involved in it and not to hang their tails on a rope that is cut three or four years before putting it on.

Geographical considerations obscure the difficulties of the problem but, if suitable personnel can be found, it is planned to initiate regular meetings with speakers on a variety of naval topics to which cadets will be able to bring their friends and talk informally over a glass of beer after the

lecture.

The possibility of arranging short visits for cadets to ships and establishments is being explored. There is even a suggestion that they might be allowed to go to sea! Time available before and the demands of the medical curriculum will inevitably make this a complicated system possible, but the results will be well worth while.

More contributions to medical student societies would be welcome and more naval doctors should be willing to make such visits. Cadets should have a chance to visit ships and visit base hospitals and research projects, so that the opportunity to stimulate interest and teach something of the increasingly wide spectrum of naval medicine will not be missed. We hope they will be proud to be naval medical cadets, that they will enjoy it and finally, that they will tell their friends.

NON-NARCOTIC ANALGESICS — THEIR USE AND ABUSE

By J. H. Calk

SUMMARY

There is now available a considerable range of non-narcotic analgesics; none are still supplied in the form of compound tablets although true synergy is rare in clinical pharmacology. The value of these analgesics is discussed and their many abuse uses outlined. Drug tablets and drug combinations constitute an important part of modern clinical therapeutics and the rapidly expanding literature is reviewed in an attempt to look clearly and concisely at the present position.

A recent copy of the Monthly Index of Medical Specialties (MIMS) shows that there are available at present 118 preparations in the group of Analgesics and Antipyretics. 49 of these are on prescription, 69 are analgesic, the remaining 51 preparations many of which are compound tablets. 34 contain some form of salicylate, 34 paracetamol, 37 a sodium derivative and 38 contain caffeine. It is interesting that 13 salt acetate preparations, 3 some form of aspirin (ASA), 10 salicylic acid, 10 salicylic acid and BENZOCONE, 4 phenolphthalein (HYPO), PARALYPO, METOCORONE and BENZOCORONE, 1 quinine (PLUSCORON) and one even contains an anesthetic derivative (BARLIDONE). A striking feature is the presence of polypharmacy because true synergy is rare in clinical pharmacology and it must be agreed that it is seldom necessary to give more than one drug at a time. We do not always remember the great consequences of compound tablets and therefore we can take the risk of adverse drug interactions. For

example aspirin may displace the non-competitive sodium (BARLIDONE) bound to plasma proteins, and the first drug may cause hemorrhage.

Aspirin abuse is particularly common in female psychiatric patients. Amongst a total of 161 patients admitted to a psychiatric hospital over a period of three months 56 (35 per cent) had ingested more than one kg salicylate or placebo. 15 out of these 56 were women of whom five had been investigated for gastric absorption and three for renal clearance while they all had a significant reduction in uric acid excretion (Murray, Tumbury and Landon, 1970). Abuse of analgesic must therefore always be in our minds when investigating patients with dyspeptic symptoms or signs of renal insufficiency.

Aspirin and Other Salicylate Preparations

It cannot improve upon Sir David Dore's remarks (1970) about aspirin which he describes as "a wonderful drug, it has an anti-inflammatory action and relieves pain, it is antipyretic, anesthetic and febrifuge; it seems to stimulate the stomach and halt the diarrhea. The common perception of aspirin indicates that we all regard it as a most useful drug in spite of its known hazards, as an irritant stomach slopener it used to be much more common in those addicted to aspirin than in the normal population (Kawachi and Shetty, 1965).

It has been suggested for years that aspirin may occasionally cause gastric hemorrhage but DeWitt (1954) appears to have been one of the first to notice that

occult bleeding occurs in about 75 per cent of those taking aspirin regularly for various complaints. Anyone who has observed the effect through the old half-worn microscope of an aspirin tablet (not in the gastric mucosa) will be surprised that some haemorrhage and perforation does not occur more regularly. There is an immediate outpouring of mucus, then profuse haemorrhage and even frank bleeding, all this occurring in a matter of minutes. The frequency of haemorrhage after taking aspirin is demonstrated by admissions to hospital throughout the world in our group (Dennis 1970) 65 per cent had taken aspirin before the haemorrhage occurred (in 30 per cent this was a regular habit and in only 17 per cent was it to be defined as casual).

Just why acute bleeding can occur after taking aspirin has never been explained; perhaps it is due to its direct irritant and occurs when several adverse factors come into play at the same time — it has been said that the process can be headed in order for an explosion to occur when substances pull the trigger (Greenman, Macintosh and Lachar 1967). The part played by gastric acid secretion has been investigated (Lubben and Yacheng 1958) these observations showed that anticholinergic substances have a detrimental susceptibility, to aspirin, perhaps related to a change in quality and quantity of mucus secreted and the mucus in contact with epitelial cells. In another series (Sjoh and McDevitt 1970) in patients who stated that analgesics had resulted that the presence of free acid in the stomach of normal could not be the only factor responsible for the observed increased blood loss in the normal group. Other observations (Blomell and Goldberg 1970) of the consequences recording of the intragastric pH after taking aspirin by mouth showed that soluble aspirin and buffered aspirin cause a significant reduction in the acidity but an anticholinergic

there is the opposite effect and it was felt that aspirin is unlikely to cause increased mucus by increasing gastric acidity except in the presence of achilodyspepsia.

Haemorrhage, gastric lesions are frequently seen when aspirin is given with a solution of hydrochloric acid but no reactions occur when sodium bicarbonate is given (Thomas, Winters, Tanaka and Marzani 1964) suggesting that it is increased acidity rather and rather than an sodium salt which opens the gastric mucosa. We also know that anticholinergic aspirin leads to increased gastro-intestinal blood loss (Koster and Gundersen 1969) and there is certainly a relationship between platelet size and bleeding; acute-gram aspirin gives rise to significantly more blood loss than fine gram aspirin (Garry and Scott 1965). Finally alcohol appears to cause increased bleeding in association with aspirin (Kleinman and Cooke 1964) perhaps because alcohol is a gastric stimulant and therefore that the effects of aspirin are increased in the presence of a lowered intragastric pH.

The other haematological problems of aspirin are well known. Reversible procoagopathy (Wynne, Snyder and Norway 1966) has been reported and the general evidence is that oral aspirin (3 g) will cause a significant prolongation of the bleeding time in normal people (Kowal, 1966) in fact per laboratory studies show that aspirin 600 mg once daily is effective in the prophylaxis of various thrombotic and pulmonary embolism in high-risk patients (Rosenberg, Harris and DeBusk 1971). The low blood coagulation and fibrinolytic state in chronic oral aspirin may be due to interference with aspirin (Scheid and Cohen 1971) whatever the cause, supplementary vitamin K₁ will reverse a low platelet number and cannot stop acute bleeding.

It has been known since 1936 that salicylates reduce glycerone in diabetes and produce symptoms related. A dose of 1.5-3 g daily can be used in the treat-

mean of the slightly diabetic Glaxolene and Thompson (1963) as some cases the blood sugar levels remain lower after the aspirin is discontinued.

The effect of a single dose of aspirin on renal function is demonstrated by the finding that there is on average 10% per cent fall in the glomerular filtration rate as measured by the clearance of labelled PFFPAR(6) (Stoddy and Kendall 1971). Aspirin 3 g daily produces 8 much greater renal tubular cell secretion than 1.6 g. pharmacokinetic study in APC compared with this (Table 1) shows over two patients with papillary necrosis confirmed at autopsy were known to have used aspirin only (Shawry Linton and Linton 1968) as showing that this drug can be nephrotoxic in certain subjects.

No experimental basis has as yet been produced to account for aspirin allergy as such, and it probably occurs through an immunological mechanism (Korolik, Elie and Hall and Spink 1969). Hypersensitivity to aspirin can be a hazard (Edmond, Hildebrand and Flann 1966) with urticaria and asthma the most common manifestations

but one can also see severe asthma and lung lesion. Asthma may persist even if aspirin is avoided and many other analgesics (paracetamol, indomethacin, dextro-propoxyphene, etc.) cause a considerable incidence in the PCN as these patients (Barnes 1968) it is therefore important that we should use great caution in excluding any analgesic to a patient known to be sensitive to aspirin and the condition might well be called 'analgesic induced asthma rather than aspirin allergy'.

In aspirin poisoning the plasma uric-acid level and its rate of change is useful in mild poisoning the levels are usually less than 35 mgms per cent and they rarely exceed 35 mgms per cent but it must be remembered that the levels may not be about as low as if blood alkaline diuresis has not been initiated (Brown, Cantarin and Milne 1963).

Phenacetin

Phenacetin has long been a constituent of compound analgesic tablets but its usage has decreased as Europe increased very rapidly during the 1950's shifting to DOL

TABLE 1
Mean renal renal values with aspirin

Treatment (mgms/kg)	Mean GFR (ml/min) or Clearance	Mean GFR (ml/min) or Clearance
PLACEDIN	1.111	1.171
PLACEDIN + ASPIRIN	0.821	1.101
CAPSAICIN	1.101	1.101
PHENACETIN	1.001	1.001
ASPIRIN	1.001	1.101
ASPIRIN	1.001	1.101
Mean Control Group	1.000	1.000
Mean (S.D.) (S.E.) (S.E.)	1.000 (0.001) (0.001)	1.000 (0.001) (0.001)

*Glaxolene and Glaxolene

†Glaxolene, L. P. Glaxolene, L. P. Glaxolene

mark between 1920-1937 and increasing by 68 per cent in Switzerland between 1930-1950. There were smaller increases in Great Britain and North America.

The first paper alleged to have called attention to phenazone as a cause of erythema by that published by Spitz *et al.* and Füllgrabe (1934). This paper was written in German and in fact, the word phenazone does not occur in it but 14 out of 44 patients had undergone drug eruptions concerning phenazone. The authors felt that the drug cases were probably the result of treatment with sulphamonomethoxine derivatives.

The term phenazone erythema¹ has been used in the literature but there is no case which can be attributed to the true ingestion of phenazone alone since this drug is only used as compound tablets and the term 'anesthetic erythema' is to be preferred. The patients tend to be women of middle age complaining of pruritis and papules with the feeling of hyperaesthesia, decreased resistance, decrease in improvement of concentrating ability, very little or no pronounced sterile pyrexia and no anorexia which appears to be more severe than the degree of renal failure (Bell, Kerr, Saunders and Vane, 1960). It is especially noted that the pruritic eruptions are considerably worse when phenazone can be withdrawn (Murray-Lewson and Lewson 1951) but the choice of an alternative analgesic is not always easy and paracetamol and aspirin alone may be necessary. Patients with an 'acute erythema' are not good subjects for single survey experiments and de Warden (1958) comments there is some and paper reactions and the other symptoms are described as particularly resistant to medical treatment (Dunbar, Taylor, Russell-Smith and Kane 1961). Recently there have been alarming reports indicating that abuse of phenazone tablets may sometimes give a severe malaise due to the cells having the renal pelvis (Harrison,

Angervall, Nilman and Lohman, 1965).

A simple chromatographic technique for the detection of phenazone metabolites has been described in five patients when the drug became known as causing it all but one and was found to induce anamnestic skin allergy reactions (Miller, Worsley and Chin 1959). It has possible causes of dark urine reducing anamnestic skin urticaria and oligospermia poisoning by photographic developers, isopropyl and methylol groups. Eighty per cent of ingested phenazone is metabolized in the liver to form paracetamol, and therefore it has been suggested that both phenazone and paracetamol should be placed on penicillamine (Kerr 1958) and de Warden (1958) but in fact there have been only two reported cases of paracetamol erythema in the literature and these were some observations about one of these cases (Kerr 1958). One report has suggested that paracetamol plus chlorazepate or LIDAZOL may cause pruritic eruptions (Korber 1967).

Investigation of phenazone erythema¹ has been hampered by the fact that experimental work in rats does not produce the same renal lesions as in man (Laker and Russell-Smith 1960). It is possible that contamination with p-chloro-benzamide is responsible (Fellward, Gabriel, Hansen and Nielsen 1961) but no renal lesions develop in rats fed with the preparation and in fact reports appear to be more likely to produce papular eruptions in these animals. There has been no interest in explaining the development of papular eruptions and chronic interstitial nephritis, a reasonable concept being that the offending drug is concentrated in it rather than the renal papilla. Solvent degradation procedures in renal damage and hydrolysis in proximal tubules and Russell-Smith (1958).

The implication of phenazone in 'anesthetic erythema' is due to the fact that almost all compound analgesic tablets have contained phenazone in the past. The

pharmaceutical industry has done much to clear this and I find that while there were 16 compound tablets in MIMS in 1963 containing phenazone, by 1971 only one could be seen, paracetamol being substituted for phenazone in these compound tablets. Moreover the Proprietary Association of Great Britain, whose members are largely responsible for establishing the rules of proprietary medicine, states that phenazone has been virtually eliminated from their preparation. Even so the British National Formulary 1971 still contains 50 tablets of ephedrine phenazone and codeine although there is a warning about the use of phenazone.

Paracetamol

Knowledge of the possible nephrotoxic effects of phenazone has brought about a great increase in the consumption of paracetamol. Acute paracetamol poisoning can lead to hepatocellular metabolic changes and acute renal failure, liver damage is found in most patients who have ingested more than 15g (Proudfoot and Wright 1976). The plasma half life of paracetamol is only about 4 hours but the metabolism of the drug is impaired in patients with hepatic injury and there is a significant correlation between the liver function tests and the half life of paracetamol (Proudfoot, Russell, Wright and Murray 1971) so that the paracetamol half life is the most reliable guide to the prognosis and liver damage is to be expected when the half life exceeds 4 hours.

Paracetamol has been investigated as a possible cause of gastro-intestinal blood clot, using labelled red cells it has been confirmed that bleeding does not occur (Hochberg and Meyers 1964) moreover sustained treatment of paracetamol over long periods has not yet been shown to impair renal function (Edwards, Edwards, Macdonald, and Taylor 1971).

Phenylbutazone and Oxyphenbutazone

Phenylbutazone (BUTAZOLIDIN) was

produced on the Continent as a substitute with analgesic (BROCFYRIN) for some years, but did not receive encouragement from its country because of the toxic reactions to analgesics. It was in the early 1950s that phenylbutazone came to be used in the treatment of gout and various rheumatic conditions in a dose of 325-1,250 mgms a day. The drug proved of value as (thrombotic) effusions and also as pain relief when the serum urea acid would fall rapidly, but it was not long before hepatotoxicity was reported and the drug fell into disrepute. The use of the dose of phenylbutazone then came under suspicion and it was observed that a dose of 400 mgms daily gave a plasma phenol level only slightly higher than 400 mgms daily (Garbus, 1955). On the former dose urea and blood dyscrasias are very much less frequent and intense monitoring of the peripheral blood picture is no longer considered necessary. It can be shown that patients with rheumatoid arthritis and synovitis, but without arthritis can reduce the dose of steroid if they take oxyphenbutazone (Harrison, 1970) (the steroid sparing effect, can possibly arise if the side effects of larger doses of either steroid or oxyphenbutazone).

Both phenylbutazone and oxyphenbutazone (FANDEREL) are prone to cause peptic ulceration whether the drug is used orally or by suppository there would therefore appear to be little value in the use of enteric coated tablets (BUTACOTIN) or in the substitution of phenylbutazone with its alkali (BUTAZOLIDIN ALKALI).

There is considerable agreement between these drugs and other preparations. For example phenylbutazone potentiates the anticoagulant effect of warfarin (Aggs, Le O'Reilly, Long and Kewin 1967) and the substitution of phenylbutazone with its cyclo-oxygenase will raise the serum urea and liver, although such drug used alone is a potent urea and liver depressant and Schmidt (1966). Phenylbutazone is also known to

enhance the hypoglycemic action of antidiabetic drugs (INDOCLIDE) used in the treatment of diabetic mellitus (Fark, Ottav, Baylis and Rosen, 1967).

In long chronic the half life of labelled phenylbutazone is prolonged compared with normals but administration with several drugs including barbiturates, paracetamol or salicylates prevents this presumably because these drugs facilitate drug excretion of phenylbutazone (Law, Shooluck and Walker, 1962).

The relationship between the inhibition of phenylbutazone and the development of leukaemia has been a subject of controversy since but in one series of 124 cases of acute leukaemia induced by chlorambucil and phenylbutazone it did not become possible to decide whether either drug was leukaemogenic (Pruett, 1967). Survey of a history of patients with leukaemia in Australia, New Zealand, Switzerland, Denmark and Westhill (1967) did not produce any direct evidence that phenylbutazone could cause leukaemia. 19 out of 131 acute leukaemia and 16 out of 506 chronic leukaemia had had phenylbutazone more than 11 months before the onset of leukaemia.

Phenylbutazone and oxyphenbutazone may mask the symptoms of temporal arteritis and polymyalgia rheumatica (Waldman and Werner, 1967) but outside rheumatic diseases, there has been some evidence that phenylbutazone may produce myelotoxic effect as Hodgekin's disease (Bachel, 1958) and oxyphenbutazone is useful in the treatment of carcinoma (Lager, Carlsen, Torsell and Skarvin, 1967).

Indomethacin

Indomethacin (INDOCIDE) has been demonstrated to be a useful drug in the treatment of rheumatoid arthritis and is regarded as an efficient analgesic which is comparable in potency to phenylbutazone (Wright, Walker and McGowan, 1968). Serum levels are usually higher after oral

therapy than after using a suppository but the levels are similar after 12 hours and 100 mg orally at night is more acceptable to the patient than a suppository (Hackett, von Taylor, Bessner, Clever and Hart, 1969). Fifty per cent of patients on indomethacin complain of headache, vertigo and light-headedness, these side-effects being dose related; a single dose of 800 mg gives rise to vertigo headache; a further 400 necessary and paracetamol behaviour while a fatal hepatitis has been described in children taking large doses for arthritis.

There has been much interest in the effect of indomethacin on gastric function with conflicting results. In one series there was an increased response to histamine in normal subjects taking indomethacin, while in rheumatoid arthritis leukaemia often produced little response but with a significantly higher output of acid when the patient was on indomethacin (Langbein, Hansen and Mikkelsen, 1967). In another investigation therapeutic doses of indomethacin were found to have no effect on the basal and histamine-stimulated gastric secretion in man (Whedee and Eberhart, 1968) suggesting that the gastric stimulation occurring during indomethacin therapy is unlikely to be related to a simple effect of the drug on gastric acid output. Gastric irritation is not, however, an unusual complication of indomethacin therapy, although occurring whether the drug is given by mouth or by suppository indicating that the effect is not a local one on the gastric mucosa. Proof of cause and effect is not always easily established but the effect tend to last rapidly when the drug is withdrawn (Table II).

There are certain other aspects of the starting drug which merit attention. Up to labelled indomethacin it has been shown that continuous aspirin ingestion causes a significant decrease in the serum levels of indomethacin (Gerny and Thomson, 1968) that would explain clinical reports

TABLE 3
INDOMETHACIN—GASTRIC ULCER
Epidemiological Features

Case No.	Site of Ulcer	Duration of Ulcer (yr.)	Protection from Medical History	Course after stopping treatment (yr.)
1	Pyloric gastric ulcer	8.0	Yes	Healed in 3 months
2	Pyloric + lesser curve	3.7	Yes	Healed in 3 months
3	Pyloric + duodenal ulcer	4.9	No	Periodically healed in 6 weeks
4	Pyloric fundal ulcer	1	Yes	Healed in 3 months
5	Pyloric lesser curve	1.8	Yes	Almost healed in 6 weeks
6	Pyloric + lesser curve	1.0	Yes	Almost healed in 3 months
7	High lesser curve	1.0	Slightly	Healed in 3 months
8	High posterior wall	1	Yes	Spontaneously
9	High lesser curve	2.0	Yes	Healed in 3 months
10	High lesser curve	2	No	Healed in 7 months with continued therapy

(Reproduced from BMJ May 4, 1974, 309)

that a combination of the two drugs is no more effective than aspirin alone. It is also important to remember that the patient's present medication may interfere with our oral investigation, aspirin and oral indomethacin cause a highly significant decrease in maximum rate of uptake in the oral or intragastric release laboratory test (Gordon, Walker and Skellern 1971).

Indomethacin is also an effective anti-painful in children, especially in those patients with very high temperatures (Glover 1964). In Hodgkin's disease the typical Peltzman fever is easily obliterated with indomethacin 25 mgm into capsule. The course of the disease is not altered but the in a useful symptomatic measure (Hartman, McCann and Kozner 1967). Indomethacin has also proved effective in the relief of pain in post-cardiotomy (McCann, Rieck and McCann 1969) symptoms tending to occur in the cardiovascular tract disseminated into early. A new use for indomethacin lies in the finding that it causes a decrease in the proteinase in all histological groups of epithelial, the proteinase releasing rapidly when

treatment is stopped (Mikelson, Verheulman, Douma and Wernersky 1969).

Aspirin

Aspirin (ACETIC ACID) is closely related chemically to Indomethacin (INDOMETHACIN) which was withdrawn on account of possible hepatotoxicity.

Aspirin appears to have analgesic and anti-inflammatory properties resembling those of aspirin and its side effects do not appear to be serious although the question of liver damage must be borne in mind. There has been a considerable development of aspirin as to the effectiveness of the drug in a dose of 750 mgm three times a day but this can be doubled (Blackmore, Platt, Skellern and Taylor 1971). Aspirin certainly appears to be an effective analgesic in the treatment of rheumatism and rheumatic arthritis in the majority of trials.

Acetylsalicylic acid

Acetylsalicylic acid is present in DISALCIN and DOLORENE. It is re-

pointed to be an analgesic roughly equivalent to codeine except that it does not cause constipation. A controlled trial of a sustained action preparation (Dipren 1969) demonstrated numerous side effects such as indigestion, dizziness, dizziness and nausea but especially depression and it was suggested that the drug should only be used at night in sedated patients. There have been reports of leucopenia, thrombocytopenia, and marrow depression when used with aspirin it has caused a dermatomyositis like syndrome. Oxidation causes CNS depression, severe respiratory depression and convulsions these cases have been noted in which pulmonary infection was a predisposing feature (Bogerts and Miller 1971).

Mefenamic Acid and Mefenamic Acid

These compounds have a closely allied chemical structure (Wander 1, 1969; Ullrich and Heinicke 1968).

Mefenamic acid (MEFENAMIC) has been shown to be a useful analgesic in acute arthritis and other chronic joint conditions. 250 mgms tds is not an effective analgesic dose but 500 mgms tds has been shown to be useful. Although 10 per cent of cases in one series did experience diarrhoea, nausea and vomiting of a mild type (Cubell 1968; Brown and Knight 1965). In three mixed arthritis (Myle, Brown and Williams 1967) mefenamic acid appeared to be superior to indomethacin and have no analgesic potency comparable to aspirin and phenylbutazone, even when pronounced side effects were pronounced.

Mefenamic acid can be used as an oral pro-drug (Belle 1971) and it has been noted to be particularly useful in children in a dose of 3-6.5 mgms per kilo body weight in the first three years of age of studies were no side effects and there were some advantages over aspirin in that mefenamic acid is available in a stable liquid form is not associated with gastric mucosal bleed-

ing and is unlikely to be a cause of acute renal poisoning. It is important to remember that the analgesic action of meprobamate (MEPROBAMATE) is not antagonized by methenamine acid or flufenamic acid as is meprobamate (Latham, Knight and Robinson 1966).

Mefenamic acid is not free from possible haematological toxic effects as even at the report of an autoimmune haematologic syndrome in three cases (Myle and Brown 1966), all three cases recovered when the drug was withdrawn.

Flufenamic acid (FLUFENAMIC) appears to have similar uses to mefenamic acid and even more pronounced side effects predominantly. There was no significant difference in the response to flufenamic acid and phenylbutazone in a double blind trial (Brown 1968; Brown and Williams 1967) as rheumatoid arthritis but it was concluded that flufenamic acid might find a place in the treatment of rheumatoid arthritis, especially when aspirin caused dyspepsia. The drug has also been used to advantage in the management of the acute reaction of leprosy, leprosy (Widdows 1966) and it may be a useful alternative to corticosteroids in this condition. Doses up to 1,000 mgms a day may be necessary but it is not clear how to keep on the possible appearance of leucopenia.

Mefenoxiprone

Mefenoxiprone (VERACTIL) is a drug with a similar action to ibuprofen used in the treatment of the acutely inflamed rheumatic patient but it has also been shown to have analgesic, pyrexia and 10-15 mgms is equivalent to 10 mgms of morphine in the treatment of post-operative pain or terminal malignant disease. The onset effect curve is similar to that of morphine and nausea is less frequent although sedation occurs more often and 15 per cent of patients are stated to have pain in the use of aspirin (Brown, Wil-

increase, Hossle and Rogers, 1966). It is obviously a drug worth having in mind when pain relief is of paramount importance.

Carisoprodol

Carisoprodol (CARISOPRODOL) is described as a muscle relaxant of low toxicity. It is chemically related to meprobamate and mephosuran and its action is stated to be central. A dose of 350 mgm tid has been reported as showing marked results in neurological spasmody, as well as due to stress (Kosman and Majors, 1963; Thompson, 1966) although the drug does entirely cause drowsiness.

Cephradone

Cephradone (present as NORCEC, DRYFAL, NORFLAX and VENTRAL-MIL) is another muscle relaxant with analgesic properties. In a dose of 100 mgm three times a day it has been shown to be useful in Post-traumatic Osteoarthritis, (Hess) and although it has some anticholinergic activity no significant side effects of this nature have been observed (Kim and Fredrick, 1964). There is some very inadequate evidence that cephradone should not be prescribed with drugs containing dehydroepiandrosterone like DASTALOCIC and GELCOSTERONE since it is alleged that the combined therapy may produce mental confusion, anxiety and tremor (Palsson and Balzer, 1970).

Diphenone

Diphenone (MYANERIN) is another muscle relaxant of low toxicity although it has been shown to produce leucopenia and marrow suppression. There is an interesting report of the change of hair colour from brownish to blonde in six patients taking this drug for three months (Lipman, 1961).

Allopurinol

Allopurinol (FALAPRIN) is a compound not product of allopurinol cycle and as

pires. This preparation may allow an increased dose of allopurinol to be given with out gastric upset.

Chlormezanone

Chlormezanone, a minor tranquilliser is a constituent of LORAN and TRANCALPAL. It is stated to relieve muscle spasm but no positive proof is available.

Ethoxyphane

Ethoxyphane is a constituent of EQUACIC, EACTRIN and EACTIPAR is a homologue of pethidine, and is stated to be efficacious in the relief of muscle skeletal pain, its potency being similar to that of codeine. Side effects are not common but respiratory pain, nausea and vomiting do occur. It is only marketed in compound tablets which can contain meprobamate, aspirin and paracetamol.

Propiomazine

Propiomazine (PORTAL) is a potent non-addictive analgesic which has been available for about 3 years. PORTAL is a narcotic analgesic and a barbiturate derivative, it is the L-isomer which is responsible for both the analgesic effect and the side effects (Forsum, Beer, Mathews, Chalmers, Miller and Paddock, 1969). When used parenterally 30 mgm propiomazine is stated to be equivalent to 50 mgm morphine (Ginsberg, 1969) and may well be a more useful drug when the patient should remain alert (Hickman, Hobbs, Borge and Solley, 1969). Propiomazine gives rise to very similar and significant reactions to the PCID when compared with morphine (Dunn, Barker and Purves, 1967) but it is of 25 per cent anticholinergic IV will temporarily reverse the respiratory depression produced by anticholinergic poisoning (Ginsberg and Bart, 1970). Inaction in the pulmonary and circulatory pressures after anticholinergic poisoning enhances the heart's work load and therefore the drug might be acceptable in

the treatment of acute myocardial infarction (Hewer, Murrell and Hobson, 1970).

Oral procainamide in a dose of 80 mg/day gives rise to only minimal sedation and it should therefore be valuable as an analgesic where little change in consciousness is required (Morris and Telfer, 1970). The same dose is more effective than 40 mg/day dextropropoxyphene (DP 151) although a larger dose may also offer (Morris, Williams and Matheson, 1970). The general conclusion is that a dose of 80 mg/day is suitable for analgesic patients and 70 mg/day for bed patients post-operatively (Dixon and Morrison, 1970).

CONCLUSIONS

There is available today a wide range of non-narcotic analgesics from which and the over-pressing problem of drug selection must be considered if we are to make the best use of them.

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ALCOHOL AND THE ROYAL NAVAL OFFENDER

By L. G. Mowry

—Bounty at the source of the form — wine of the hour—

Amphibian

Introduction

The relationship between alcohol and criminality has been long established and has been the source of moral censure and expiation over the centuries. Colquhoun writing in 1783 in 'A Treatise on the Police Force of the Metropolis' commented "there is scarce any moral evil by which society is afflicted, the most debauched, the nation's master and servant destroyed, and the ruin of families and individuals afflicted which is not promoted in the Public house".

Speculations of course this relationship has been modified and more recent experience has confirmed this view. However, the figures vary from one survey to another. Robinson, Patten and Kier (1961) reported that in HM Prison Brixton during a period of six months in 1960 34 per cent of offenders had taken alcohol at the time of the offence whereas Kinsberg, Ingh and Lindberg in 1961 stated that in California 50 per cent of males brought before the judges committed their offences whilst under the influence of alcohol.

The object of this investigation was to repeat and see the relationship between alcohol and offences in the Royal Navy in order to evaluate this problem.

Method

A survey of 100 offenders committed to Royal Naval Detention Quarters during the period May-November 1968 was made

viewed. Demographic data were collected and certain assessments made. The type of offence committed fell in a one of three categories:

- a offences of material gain such as theft, smuggling and larceny
- b anti-social offences such as offences against persons and useful damage to property
- c offences of dishonourment — those offences demonstrating antipathy to the Royal Navy such as desertion, absence and those accessories offences of striking a superior officer and mutiny when these offences are motivated by dishonourment.

Offences of dishonourment were excluded from the survey. They numbered 12 of the 100 offences.

An attempt of the amount of alcohol consumed was made from three sources: the recommendation letter (the letter sent by the commanding officer giving a summary of the case), evidence from witnesses of the offence and the testimony of the offender.

This letter was treated with caution as being drunk at the time of the offence is a common non-legal excuse and a temptation therefore made to exaggerate the amount the offender had to drink. It was decided not to accept less than six parts of four or its equivalent (approximately 180 g) alcohol consumed in a period of not more than four hours before the offence as evidence of the possible role of alcohol in the genesis of the offence.

Finally a clinical assessment of personality disorders was made, taking into the past history, personal biography, social structure and criminal tendencies of the offenders. It was supplemented by the observations of the medical staff and further interviews of the offenders with them. The survey was only concerned with the presence or absence of personality disorder.

Results

A total of 139 offenders were each found to have committed approximately 100 g of alcohol in the four hours or less prior to their committing an offence—representing 56.7 per cent of the total and including 22 (5.5 per cent) committed the drunkenness charged against the type of offence. It was found that 100 violent offences were linked significantly with the consumption of alcohol prior to the offence (Table 1).

The greatest incidence of personality disorder was found in the overall group of alcohol-linked offences, whatever the time prior to the offence. However, when age was taken into account, a somewhat different picture emerged. The greatest percentage of this type of offence occurred in the youngest group (18-45 years) and the oldest group (over 55 years), but whereas in the youngest group the proportion of personality disorders was lower than the average for the population in Royal Naval Dockyard, Devonport, the incidence in the older group was much higher (Table 2).

Discussion

In any discussion concerning the use and abuse of alcohol and the associated offences thereof, it is necessary to consider the cultural setting in which the problem occurs. The Royal Navy has a tradition for free

TABLE 1
Relationship between alcohol consumption and type of offence

Offence	Total Offences	Was linked with alcohol (%)	Significance
Mutual pug.	41	9 (21.9)	Not significant
Drunkenness	158	51 (32.3)	Not significant
Assaulted	98	76 (77.6)	P < 0.001
Total	197	126 (63.9)	

TABLE 2
Relationship between age and personality disorder in alcohol-linked offenders

Age	Total in Group	Was with alcohol linked offence (%)	Was of alcohol linked offences with personality disorder (%)
16-17	11	25 (100.0)	1 (9.1)
18-24	128	28 (21.9)	27 (21.1)
25-34	141	45 (31.9)	38 (27.0)
35+	15	18 (120.0)	14 (93.3)
Total	195	86 (43.6)	79 (40.5)

downplay and at the same time to come more into other closed rank communities hard drinking. In such communities an increasing tolerance or perhaps better tolerated and more often masked flag as a more conscious group. Nevertheless there are issues which any survey aims to be pleased to discover. It is therefore not surprising that this survey finds that of those committed to Detention Quarters for offences other than drunkenness 36.7 per cent had consumed approximately 180 g or more of alcohol within four hours of committing the offence. Compared with other surveys, this is low and may indicate the liberal nature of Naval discipline beyond which the soldier returns at his post.

In contrast with other studies the offences committed by seamen who'd alcohol fell mainly in the age social group. Erikson (1961) found that in the category of assault and damage to property 78 per cent of offenders were under the influence of alcohol compared with 34 per cent of those convicted of theft. This finding was supported by Hansen (1962). Bartholomew (1964) surveyed a prison population and found that 41.3 per cent of offences against the person were committed either whilst under the influence of alcohol or the offender had been drinking at the time of the offence. He concluded that alcohol plays a particularly outstanding part in aggressive offences. Fleisher (1964) comments 'alcohol is not likely to bring out the very best that is not potential in a personality nor is it likely to give behaviour into put names for which there is not already signal and predisposition. The alcohol merely facilitates expression by removing its inhibitory processes'.

Where the naval offenders are graded by age, it is noteworthy that it is the youngest in the sample that have the greatest percentage of alcohol linked offences, and that in the older group there is a three fold increase in the incidence of personality dis-

order. It is arguable that this, along with limited by experience, but there is a personality disorder do not and go on serving and further offences to become a habit problem in itself and that this study shows these two classes. However what is more probable is that the differences but the similarities in the two groups. The young group there is evidence of symptoms, but that alcohol remains their prevailing motif whether in danger coming to achieve pay or to secure housing, and in the later event came an offence to be committed. The older soldier with personality disorder is in the more vulnerable state his emotional life being unimpaired not by his youth but by their combat and difficulties that have caused his personality disorder.

Since the completion of this survey the Royal Navy has stopped the use of rum, which until August 1966 was issued to all men over the age of 30 when they were allowed to keep the privilege. Whilst this action in itself will probably do little to reduce the number of alcohol linked offences it might go some way to producing different social attitudes with respect to alcohol. This may prove to be of little advantage to those with defective personalities but could well influence the young who are not so long in the way where it is not for the Naval Discipline Act will ensure that at the best it might be a warning and perhaps like an older (Proverbs 20 12).

Summary

A survey of 400 offenders in the Naval Naval Detention Quarters was made. 36.7 per cent of all offences were linked with alcohol consumption prior to the offence the greatest proportion of these offences was non-violent. There was a much higher incidence of personality disorder in the older group of sailors who committed alcohol linked offences than in those in the youngest age group.

- [illegible]

MOROCCAN BOAR HUNT

By E. B. Macdonald

Pope John would be a good hunter who could believe in the Moroccans. I pulled on an other woolen sweater and a hat and I stepped out into the Tangier night. It was 5 am and all lights were on. Arabs stood in their hooded djellabes, gathered on guard at the entrances to private pensions, while Europeans in European dress on their way home some mysterious and often easily changing variety showed in each other. We took a short cut through rather gloomy streets, passing huddled forms sleeping in corners, hearing strange music drifting from dimly lit passages and pop blasting from an open window above a darkening open gate. Most people were in doors, but life obviously went on again through the night in this one-time oriental coastal city. Decrepit exhausted heads in coats a whirl of apens, the smell of gun and sometimes even perfume.

Cafe Souley

We met our friends and their wanted much to do. Guns loud and warm were piled into the Land Rover, followed briskly by men and dogs. Now we were off through the early morning traffic over horizontal peasant women crouching in the sun, back to back and laden with massive piles of vegetables, chickens and even stacked high with boxes of fruit from the cycles, all headed along with business in mind. We pulled up by a cafe. The pavement was crowded and the tables and chairs pulled into the street, all in the better glass from the restaurant within. So many people so early. The sound of the puffed, bubble of a dozen languages. Men were

wrapped up in woollen sweaters and a cluster of Arab women, both veiled and veiled, flashed bright eyes from their covered faces and rummaged through or high hooded caudles, showed below to bring the usual carriage. Groups of young Arab girls in white gupples with their oddly checked happy boy friends just like any where in the modern world. All were drinking coffee out of glass tumblers hot and sweet, and with looks instead of just to start the day. It was the last weekend of the hunting season and many of the crowd sported bandoliers of cartridges round their shoulders. Altogether that showed on the pavement illuminated in a dark moon looked highly dangerous and to an untrained eye might well have looked much like

Now we were off into the Moroccan countryside. Long straight roads made the journey smooth and sure and then all but the driver were killed in half a mile downing at the day ahead.

The Tangier

An hour and a half later we turned off the main road and were bounced into full awareness. We climbed up a steep track leading through scrub to the dark woods, winding as and on up and down splashing through streams and eventually through the trees to look on a clearing. There was a huge flat blank in the middle and we gathered round. The flanking forest lay up the faces of a limestone looking crowd of Arabs and their even stranger looking dogs, dozens of them. The men were one breed of dog. It was getting light now



Fig. 1. *Amphispiza bilineata* nest site.

and birds, we set off down way to the road passing through the fire which we were told occurred that we would find bears and shoot with the one get home but there was a strange smell about and the whole process seemed and I think refused our horse entrance (Fig. 2). From we were off with the two getting higher and the temperature rising rapidly. We pushed through scrub



Fig. 2. *Amphispiza bilineata*.

growth, I saw though was dead bilineate red. As I did, we were told, it shows where to find and was

Pigs

Three or four overgrown paths led from the small clearing looking like the entrance to tunnels through the thick grass. We were told that to men would mean pumping but as the men knew where he was going and intent to get there. There was not much room for lots.

After a while the silence was shattered by a shot, the breaking out of a wild noise of bullets and the swirling of undergrowth. Everywhere grass and the scene are very much coming out way. There was a terrible feeling of expectation tension and hope. Another shot cracked over by and the crashing pursuit ended. The heavily cropped coffee and trees showed. The bear was dead shot by the gun at the next stand (Fig. 3).



Fig. 2. The pig.

It would be hard to describe a pig if I did not give a description of the animal which was certainly the first I saw in the country. It looked a little dead (Fig. 2) and all this would seem to the owner. It did not even look like a beast. It seemed out to be the best hunter in the park and would lead a pig if it was the only one in the country. It was also a dear friend of the family. Much laughing and a good many delays eventually convinced the thoughts and heart broken men into an increasingly happy and proud Arab. Perhaps it was good that the animal was killed. The dream could not have lasted much longer.

When the excitement was over we had our food and meat and noticed the horses waiting in groups, not eating or drinking but passing the hot pipe round the circle.

Help

In the afternoon we came to different territory, a vast undulating strip through which our horses advanced, shouting and shouting strange noises. Some came forward, offering very high prices, and sometimes as they to stop can be (Fig. 3). This was a more familiar kind of shouting, but a good ending to an unusual day's work.



Fig. 3. The people.

CASE NOTE

PAROTID CALCULUS

Dr. P. B. Jackson

Patient with 10-year history, and there is no clinical appearance suggesting the surgical management of a calculus in the intra-glandular part of the parotid duct. The report of a single case is therefore presented.

A commensurate exposure gave a history of a swelling in the region of the angle of the jaw on the left side which had been intermittently present for several months. Examination revealed a firm, ill-defined lump 1.5 cm. in diameter overlying the angle of the mandible. The parotid duct orifice appeared normal and the other from it was clear. An incision posterior to-ridge of the left parotid revealed a rather opaque calculus (Fig. 1) which by radiogram was 0.7 cm. of length showed (Fig. 2) to be in the intraglandular part of the duct.

Under general anesthesia a pre-auricular incision was made and the skin flap is flexed forward to reveal a subfascial or ductal mark. Palpation failed to locate the stone and the duct was exposed as it emerged from the anterior border of the parotid gland. The duct was then carefully followed into the gland and exposed by blunt dissection until the stone was located at the point where the duct turned down wards towards the lower pole. Stay sutures were inserted and the duct opened. The stone which was brittle was removed to-gether with some tiny fragments. There was no immediate effect of when fluid from the duct and subsequently found to be sterile on culture. The duct was repaired, three corners of 4-0 plain catgut were used to

close the incision, care being taken to ensure the suture did not lie in the lumen and suction drainage applied.

The post-operative course was smooth.



Fig. 1. Intra-auricular incision. 1 cm. x 1.5 cm. x 0.7 cm. (width) x 0.4 cm. (height) x 0.3 cm. (depth).



Fig. 2. Indication of parotid duct (A) and its connection with the sublingual gland (B).

forward a small area of anastomosis at the angle of the parotid duct resulting from division of greater auricular nerve fibres, occurred at a few weeks.

DISCUSSION

A search of the literature has failed to give reliable information regarding the existence of parotid calculi. Patey (1965) in his series of 48 cases of chronic and recurrent parotitis found eight cases due to calculi though he added the frequency of parotid calculi is generally well tolerated and these patients often ignored. The surgical management depends on the location of the calculus. Some to be considered are:

1. separated at the duct orifice or lying in the adjacent subcutaneous part of the duct
2. in the sublingual part of the duct as it has entered the buccinator
3. in the sublingual part of the duct

4. within a sublingual gland cyst.

A calculus at site 1 should be removed via the mouth. Seward (1961) describes an intracutaneous approach but calculi at site 2. A calculus within a sublingual gland cyst being surrounded by gland with immediate drainage is probably best treated by superficial parotidectomy. In the case reported the calculus was at site 3. Patey (1965) states the two common sites for the impaction of parotid calculi are at the bend of the duct into the mouth and at bifurc of the gland.

Woolley (1976) dealing with the management of chronic enlargement of the whole parotid salivary gland states that the stone must be removed if it is palpable in the cheek and cannot be milked forward by sucking down on the stem from the cheek with great care for the two inch bearing hand as in Woolley. Patey (1965) advocates the more proximal Stensen's approach described by Seward (1961) around minor sublingual and maxilla. Though a more lengthy procedure it provides good exposure and it produces no noticeable scar.

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a member of the Royal College Hospital nursing staff and was shot on the evening occasion.

The accidental death of the cousin of Lieutenant (and later) the Navy of a wife (Captain) Major (Colonel) of a land war. It almost to love and his parents of a land war. One means happily paid out to his whole family in their single hemisphere.

JOHN WILSON FLEWEL LELAND, 1911-1912.

Mr. Leland, who died on January 14 1912, at the age of 36, was a former American Civil Warman who spent the whole of his career on the Medical Department of the Royal Navy. He joined as a General Division Clerk in 1900 and retired as Civil Assistant to the Medical Director General in 1910. He paid of 1910-1911 and in the same year, in 1911, he was promoted to Major. Mr. Leland's life was spent, with the exception of his last years, with the Medical Department of the Navy, and he was promoted to Major in 1911. Although held in high regard by the Medical

Service of the Navy, and associated with the Navy, the service officers with in the service who were in the service, in the early days of their career, it is hardly surprising that they were a long and well-known relationship. There doubt to be the very first people presented to, followed by members of his long career of other. Members of the service, however, it was the strong conviction of his whole with respect and interest for a new career and career, usually in the Navy, and the whole, perhaps the most and some of the great one of war and experience which he obtained in the Admiralty, as well as in the service of the Medical Department. It is unlikely that any other member will ever achieve such a long and great career with the Medical Service as did Mr. Leland.

He began his career, one of which in a former position, Captain and serving in the service of the Navy, and the other, in the service of the Medical Service, and the other, in the service of the Medical Service, and the other, in the service of the Medical Service.

REYNOLDS AND JAMES

New Navy Surgeon—1971

Officer of the Order of the British Empire
Surgeon, Commandant R. M. Reynolds MBE
1967



Surgeon, Commandant R. M. Reynolds

PROMOTIONS

To Surgeon, Vice Admiral and Medical Director
General (Retired)

1. Vice CDR, RM, MC, 1967.
Surgeon Rear Admiral Wilson is Dean of Naval
Medicine and Medical Officer in Charge of the
services of Naval Medicine. He is a Com-
mander Surgeon and was formerly the Professor
of Naval Surgery.



Surgeon Rear Admiral Wilson

To Surgeon Rear Admiral

C. J. T. McIlwain CBE DPM MCPS 1967
DPM

Surgeon Captain McIlwain is an I.M.D. for
years, formerly, Superintendent Officer at the
Royal Naval Hospital, Malta.



Surgeon Captain C. J. T. McIlwain

To Surgeon Rear Admiral

A. C. Evans MBE CBE MCPS 1967
DPM 1967

Surgeon Vice Admiral Evans is Deputy Medi-
cal Director General and has been a Director
of Naval Medicine since 1967. He is a
Vice Admiral.



Surgeon Vice Admiral Evans

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EDITORIAL

Up-to-date in its long and distinguished history of the Royal Naval Hospital Plymouth, recommended by Surgeon Captain Pugh in the first of two articles to appear in this Journal, presents a living testament to its continuing influence represented in this number by three interesting clinical contributions among one of the current interests of the departments of internal medicine and diagnostic radiology. In recent years the hospital in Plymouth has rapidly extended the volume and scope of its work to embrace a wide spectrum of those provided by an extensive clinical practice which includes the very young and the elderly, thus complementing Haver as a clinical centre in the West Country.

Two years ago a new children's ward was opened and a new accident and emergency department in building is enabling the hospital to assume responsibility for all casualty work in the Devonport, Stoke and Southcombe areas of Plymouth. Progressed care and intensive care units will be completed by September. At the same time a department of plastic surgery under a clinical consultant will be commenced in the ward hospital.

The department of diagnostic radiology has been equipped and re-equipped. It is a new unit of the most modern in the South-West for which a pavilion is under way in lymphangiography and has collaborated closely with the Medical Research Unit in HM Naval Base, Devonport in elucidating the features of infectious disease and in establishing new diagnostic criteria.

A number of clinical research projects is being currently undertaken and the hospital will be the coordinating centre for a major research programme on Cardiac alterations in the Royal Navy. The hospital

has also helped pioneer new techniques and was amongst the first in the country to adopt methods for the internal diagnosis of fractures advocated by the A-G group of X-ray surgeons which now appear to be gaining increasing acceptance throughout the world. A major redevelopment study of hospital facilities has recently started and being as its primary objective the improvement of wards, outpatient facilities, dental accommodation and new manoeuvres with subsequent modernization of remaining facilities in the present site, but preserving its unique history and environmental features.

The Royal Naval Hospital Plymouth to which the members of the Journal are largely devoted continues its long tradition of service to the community and offers a working practice to its specialists and consultants who today find a stimulus in creative thinking in an agreeable West Country environment.

It is with pleasure that we report the death of Surgeon Captain J. M. Cliff, Professor of Naval Medicine whose obituary appears on page 141. Surgeon Captain Cliff was a member of the editorial committee of the Journal and the Clinical Research Working Party to which he brought his considerable intellect and wealth of experience. He carried an immense influence upon naval medicine and was a loyal and generous colleague. We extend our deepest sympathy to his wife and three sons.

4 The Royal Naval Hospital Plymouth, taken from the top of Trafalgar Road.

chased from Henry Toller, Esq. by the Commissioners for the Sick and Wounded Seamen. However this land 35 Acre in 1420 was not sufficiently large and apparently served no valid purpose for a further 64 years, when it became the Naval burial ground. The date conveyed for another two years until on June 14 1758 further land in the Goosehouse area 80.28 Acre in extent was conveyed by deed to the Commissioners of the Navy by the Right Honourable Lord Edgworth and the Right Honourable Richard Walsingham. The purchase price was £1,200 £10 10d. The land conveyed which lay between No. Five Field and Goosehouse Creek consisted of two fields after it and it was on this site that the building of the hospital commenced in 1758. According to Davies (1931) a large and important ecclesiastical building known as The Abbey formerly stood there. When removed of this building was demolished when the hospital was built it seems likely that it was a Cistercian House belonging to Buckland Abbey the abbot of which at the time of the founding of Rotherhithe expressed much concern over the scheme amongst other places.

The Naval Design of the Hospital

Plymouth Hospital was built on the block system and was the earliest specimen of a hospital in this country with a limited number of patients in each block building (Tait 1961). Apparently in early in November 30 1754 a London letter to Alexander Rowland Alexander Rowland or Rowlands was appointed as overseer and to be in constant attendance at the works (Kiloh 1960). Although Rowland is generally credited with the design of the hospital (Lloyd and Coulter 1961) the views of the distinguished civil

and and past President of the Royal Academy Sir Albert Richardson (1899-1964) were that the hospital was built probably from plans by William Robertson (1720? 1775) the style of the building being remarkably similar to the architect's work in London (Richardson and Gill 1954). A fairly representative of these apparently diverging views is that Robertson who was clerk of works to Greenwich Hospital in 1746 and assisted Walpole in executing the plan for St. Andrew's Hall 1750-75 was consulted by and executed a professional scheme on Rotherhithe.

The Opening of the Hospital

Doobrow the war added an element of urgency to the building scheme for it seems that although the basic construction was not completed until 1762 a part of the hospital which had been divided earlier was opened for the reception of patients in 1760 little more than two years after the purchase of the land. According to the manuscript of the late Henry Woodcock, Esq. the first patients were transferred from accommodation that had been provided for sick and wounded sailors in a building at the bottom of George Street, Goosehouse - which was a millhouse (Harbord 1959). This transfer took the attention but the hospital ship Camberwell continued to accommodate the sick until November 28 1762 when her commanding officer Lieutenant Montgomery received orders to pay off his ship and transfer his patients. By then it seems the hospital was a fully going concern.

The Physician and Council

In its early days the affairs of the hospital were managed by the Physician and Council - a body composed of the Physician the most senior doctors of the hospital the Agent and the Surgeon usually making a total of seven. The functions of the Agent and Surgeon were con-

Goosehouse is a continuation of Plymouth Street on the west, reported by Goosehouse Field from Devonport.

worked with systematic and unerring dates. The Physicians and Council were subject to the control and direction of the Sick and Poor Board (Royal and Civilian, 1961). It seems there were two physicians, Dr Parr and his junior Dr Walker, and two surgeons, Mr Gorch and his junior Mr Pape, in addition they had the services of two apothecaries and a dispenser.

Dr Parr an Edinburgh graduate was one of the only three genuine Doctors of Medicine in the service, the others being Robert Robertson a Greenock and the renowned Thomas Trotter. The degrees of all the other physicians had apparently been obtained by proxy (Trotter 1983).

John Howard's Visit

The great philanthropist John Howard visited the hospital on several occasions and described it in his three volumes *The State of the Prisons in England and Wales*. Dr Parr obviously helped him a great deal with his researches and was referred to as the worthy and experienced physician of the hospital (Howard 1760). Howard described how each patient lay on a bed of straw (Fig. 1A) which might be advantageously adopted in prisons, particularly in the sick rooms. The beds or cradles as Plymouth are known, stretch from the floor, three feet one inch high at the head

and two feet three inches at the feet, yet but two inches long, and three feet one inch wide on the floor. The boards on the sides stretch four eight inches long, such as in each piece. A cushion lies length by two boards at the back of each cradle, which is necessary only as a safeguard. To these cradles are two mattresses, bedding etc. He thought the construction of the hospital not in several respects, angular and apparently well considered, and gave a view of it and a ground plan (Figs 1B and 1C) such supplied by Dr Parr. His description of the hospital is a fair account of the prison, opportunities at that time.

The ROYAL HOSPITAL for the reception of sick, and hurt mariners and sailors is situated in Southwark, nearly opposite to the two towns of Plymouth and Plymouth Dock, a small town of the same name given by King George, upon the hospital, well calculated of beds to hold at the order given by the case of half blood tide.

It consists of eleven large buildings, and four lesser, the whole forming a square but the whole being such a size for the purpose of admitting four thousand of an average of patients, the several disorders, in such manner as they may prevent the spread of contagion.

The buildings are work cradles raised in the neighbourhood with barbed wire water pipes, and in front is a building externally supported by many trees, of five with a 14 feet covered with lead which serves as an open ground for the patients in hot weather.

The buildings (cradles) of the centre or chapel building with necessary accompaniments in all 60 beds each and will now currently hold 20 cradles, and as the necessary work of required 25 so that only four well-grounded work cradles of the cradles with 1,500 patients may be an emergency for present use.

The ground floor of the centre or chapel building contains the dispensary, floor, two surgery and dispensary, apothecary, the first floor the eight central rooms with apartments on the first and the side story for the patients, second surgery, room, and dispensary, etc. The area in the middle of the hospital is beautifully laid out with great plans, surrounded by great walls which are high in very good order. Besides



Fig. 1. Type of bed used in Plymouth Dock Hospital in 18th century.



Time (hr)	Temp (°C)	Pressure (mm Hg)	Volume (ml)	Weight (g)	Yield (%)	Ref.
0.5	100	10	10	1.0	10	1
1.0	100	10	10	1.0	10	1
1.5	100	10	10	1.0	10	1
2.0	100	10	10	1.0	10	1
2.5	100	10	10	1.0	10	1
3.0	100	10	10	1.0	10	1
3.5	100	10	10	1.0	10	1
4.0	100	10	10	1.0	10	1
4.5	100	10	10	1.0	10	1
5.0	100	10	10	1.0	10	1
5.5	100	10	10	1.0	10	1
6.0	100	10	10	1.0	10	1
6.5	100	10	10	1.0	10	1
7.0	100	10	10	1.0	10	1
7.5	100	10	10	1.0	10	1
8.0	100	10	10	1.0	10	1
8.5	100	10	10	1.0	10	1
9.0	100	10	10	1.0	10	1
9.5	100	10	10	1.0	10	1
10.0	100	10	10	1.0	10	1
10.5	100	10	10	1.0	10	1
11.0	100	10	10	1.0	10	1
11.5	100	10	10	1.0	10	1
12.0	100	10	10	1.0	10	1
12.5	100	10	10	1.0	10	1
13.0	100	10	10	1.0	10	1
13.5	100	10	10	1.0	10	1
14.0	100	10	10	1.0	10	1
14.5	100	10	10	1.0	10	1
15.0	100	10	10	1.0	10	1
15.5	100	10	10	1.0	10	1
16.0	100	10	10	1.0	10	1
16.5	100	10	10	1.0	10	1
17.0	100	10	10	1.0	10	1
17.5	100	10	10	1.0	10	1
18.0	100	10	10	1.0	10	1
18.5	100	10	10	1.0	10	1
19.0	100	10	10	1.0	10	1
19.5	100	10	10	1.0	10	1
20.0	100	10	10	1.0	10	1
20.5	100	10	10	1.0	10	1
21.0	100	10	10	1.0	10	1
21.5	100	10	10	1.0	10	1
22.0	100	10	10	1.0	10	1
22.5	100	10	10	1.0	10	1
23.0	100	10	10	1.0	10	1
23.5	100	10	10	1.0	10	1
24.0	100	10	10	1.0	10	1
24.5	100	10	10	1.0	10	1
25.0	100	10	10	1.0	10	1
25.5	100	10	10	1.0	10	1
26.0	100	10	10	1.0	10	1
26.5	100	10	10	1.0	10	1
27.0	100	10	10	1.0	10	1
27.5	100	10	10	1.0	10	1
28.0	100	10	10	1.0	10	1
28.5	100	10	10	1.0	10	1
29.0	100	10	10	1.0	10	1
29.5	100	10	10	1.0	10	1
30.0	100	10	10	1.0	10	1
30.5	100	10	10	1.0	10	1

where there is a large army present is a reminder that while, according to all the UN rules,

At the higher end of the spring ground on the north is a large reservoir of water which by means of a chain pump, draws the water into a higher channel which by one further channel the water by means of

the primary effect of the 1990s was to bring the trade liberalization agenda back to the forefront of the policy agenda. The 1990s also saw the emergence of a new generation of trade policy scholars, who have been instrumental in shaping the current trade policy agenda. The 1990s also saw the emergence of a new generation of trade policy scholars, who have been instrumental in shaping the current trade policy agenda.



1. *Staphylococcus aureus* (ATCC 12228) and *Staphylococcus epidermidis* (ATCC 12228) were used as reference strains.

Fig. 1. A: Plot of $\ln \bar{M}_w / \bar{M}_n$ versus $\ln \bar{M}_w$ for the polymerization of MMA in bulk at 70°C. B: Plot of $\ln \bar{M}_w / \bar{M}_n$ versus $\ln \bar{M}_w$ for the polymerization of MMA in bulk at 70°C. C: Plot of $\ln \bar{M}_w / \bar{M}_n$ versus $\ln \bar{M}_w$ for the polymerization of MMA in bulk at 70°C.

The Visit of Tison and Condouk, 1793

Two prominent French surgeons, Jacques Tison and Charles-Augustin Condouk, were sent to England in 1793 in view of proposals to study hospital conditions in view of reforms proposed by the Academy of Surgery in Paris (Tison, 1794). Tison and Condouk visited Plymouth Hospital on July 11-14, 1793, having at each visited most of the hospitals in Europe and given preference to a tour of others in regard to the questions of construction and distribution of the buildings (Blane, 1799). The attending fact emerges that the Royal Naval Hospital became the principal commission for the reform proposals of the French before the Revolution and for the construction of hospitals in Black-type hospitals in France even in the nineteenth century (Gibson, 1907). It may well have been that Tison was influenced by Blane's shared observations that in periods of war there had been a substantial improvement in the hospitals there at Hither (fig. 2). Blane argued that both institutions were fairly considered as models of what hospitals might be, and were probably second to none. The chief difference in the two hospitals concerned in

the size and distribution of the buildings. Hither life-sized contained of one great iron building and four pavilions running backwards from each corner of it. These were placed in pairs, standing parallel and very close to each other longways so as to surround the first corner of the Plymouth Hospital consisted of 11 separate pavilions and equal buildings ranged in a large square with wide intervals between each. Blane concluded that the superior solidity of Plymouth shone out so far as regards the building, seems to consist in there being fewer apartments under the same roof so that there is a singular mass of land as to be covered all and in the several buildings are separated each other from the first corner of the exterior air.

Reflections in the Administration of Plymouth

That in the common professional ability of all and the popularity of a large part of the medical staff it is apparent that all is well in Plymouth towards the end of the eighteenth century. Tison appears to be no doubt that the administration of the hospital by doctors was a disservice. Truly it seems that the cause of their lack of success was not, as might be supposed, that they were so overwhelmed by their professional duties, that they had little time to spare for such sundry chores as the administration and disciplinary management of the establishment, but rather that they abused the privilege of being allowed to interfere in general professional practice to an inopportune degree. We are, and in the William Kingham's memoirs that Mr. Gough had in different previous periods, as the others did too.

But to return and remembering the observations of such visitors to Plymouth as John Wierley and John Howard it is now generally accepted that both Plymouth and Hither during the first four decades of their existence, were veritable models of

	1793-1800	1793-1800
	No. of Patients	No. of Patients
1. Tison and Condouk (1793-1800)	1,000	1,000
2. Tison and Condouk (1793-1800)	1,000	1,000
3. Tison and Condouk (1793-1800)	1,000	1,000
4. Tison and Condouk (1793-1800)	1,000	1,000
5. Tison and Condouk (1793-1800)	1,000	1,000
6. Tison and Condouk (1793-1800)	1,000	1,000
7. Tison and Condouk (1793-1800)	1,000	1,000
8. Tison and Condouk (1793-1800)	1,000	1,000
9. Tison and Condouk (1793-1800)	1,000	1,000
10. Tison and Condouk (1793-1800)	1,000	1,000

Fig. 2. This table appears in Dr. Gough's *Observations on the Plymouth Hospital in 1793* (London, 1799). Note: Blane, *Journal of the Hospital in 1793* (1793) and the period 1793-1800, says that the data are available at Plymouth (then at Hither) and then forwarded to some other hospital.

legible, and superior in which the shipwrecked were regarded and treated quite better than a convicted criminal. The legendary conduct of the nursing staff is associated with drastic and satisfactory moral living and virtue of one sort or another (Lloyd and Connor 1961).

There were women and married men but they brought no real relief to the sailors, since the latter thought them to be even worse women would be to create two families on college (Lowe, 1966). They had no sort of housing at all and were paid about half a crown a week. There were some exceptions but most of them being so poorly equipped were strictly prohibited and of the lowest class. They felt a great of trouble and worked behind them. They brought a drink for the patients and helped them to eat. They stole the property of the dead and the living and were not doing anything to help the sailors.

I once spent a letter of George Wilson on old Greenwich Hospital who spent some time at Plymouth Hospital. The nurse of the hospital was, chief of the first medical being accustomed to the manners and customs of sailors these letters were extremely bold and rude and without concern made use of the most obscene observations and actions in their common conversation. I had a great deal to do to regulate the temptations I met with from these sailors.

Thomas Trotter

Thomas Trotter, Physician to the Fleet, conducted the education in Plymouth as an assistant master (Trotter, 1855). When I hear of the medical members of a public institution having accomplished thirty or forty thousand pounds by the private exercise of his profession by an immense number of imagination the ghosts of an even thousands of brave men and to my view who have fallen into premature death by unprincipled neglect.

At the beginning of the first a woman fell from the top of a ship being at Plymouth and was wounded fatally. He was immediately conveyed on shore but nobody could be found to open the gate of the hospital. As the papers are abandoned but not a surgeon could be found he was attended a gentleman of great fortune in Cornwall. It was to be added that he died of haemorrhage from his wounds. Captain Richardson, Bates and Ward can relate the particulars of this case.

The Board of Inquiry of 1794

Trotter was so shocked by what he saw both at Haver and Plymouth that in June 1794 on his appointment as Physician to the Fleet he showed a list of his duties to submit to his superior officers who he considered to be disinterested in the naval hospital. An official Board of Inquiry was appointed whose most important recommendation was that we should regularly check observations without giving it appears to us that the distant government of this hospital must ever be defective and liable to much abuse so long as the present officers remain so near upon the footing, no strong force strongly recommended the appointment of a Governor to be taken from the list of Captains or the Navy who with the assistance of a Lieutenant should have the inspection and superintendence of the whole and from his general knowledge of the habits and dispositions of sailors we conclude this appointment would be attended with many advantages.

The Governorship of Captain Richard Cochrane 1795-1834

The new administrative system for Naval Hospitals operated through an Order in Council dated July 3, 1795. On August 4, 1795 Captain Richard Cochrane a Post Captain of 15 years seniority received a Commission as from the Lords of the Admiralty dated July 15, 1795 appointing him



Fig. 1. Captain Richard Croft, 18th Earl of Howe (1724-1804). He was promoted to King George III at a later on his appointment. They fell based on a religious struggle during which he helped himself for the noble, ideal, serving Admiralty Department and the Court members for the Sick and Hurt.

Governor of the Royal Hospital at Plymouth (Fig. 1). On the following day Croft was promoted to King George III at a later on his appointment. They fell based on a religious struggle during which he helped himself for the noble, ideal, serving Admiralty Department and the Court members for the Sick and Hurt.

Probably the most important event in the long history of the Naval Hospital was Richard Croft's arrival on the morning of Thursday August 23 1795. An upright man of tremendous stature and yet he must be was destined to guide the hospital through the difficult years of the Napoleonic Wars and to remain at the helm for over half a century. He was born on the 14th of March 1724 and died on the 14th of March 1804. He was promoted to King George III at a later on his appointment. They fell based on a religious struggle during which he helped himself for the noble, ideal, serving Admiralty Department and the Court members for the Sick and Hurt.

appointed would hold office for no longer than three years at a time.

The Private Struggle and the Naval Hospital

Croft left no personal or practical documents behind him, and his only surviving work, a period of just over four years after his appointment (Croft 1799). It is held in the Library of Plymouth Hospital. His, as later journals have come to light, though it seems hard to believe that so powerful and energetic a man would have given up so suddenly. Further, a remark like 'I am not well' is not to be taken as a sign of the end of the world, but also into the character of the author who it seems, during the four years in question did not take a single day's leave. Moreover, on only two occasions did he fail to be present for the Sunday Evening Service in the Hospital Chapel since when he attended on the same of 1795 the Duke of York on a visit to Maker Camp and when he was promoted by independent.

Croft, started to be succeeded to go on.

August 26. Took possession of the Government of the Hospital. Found Letters from Lord Howe and Mr. Pitt to that effect. I have not yet been able to appear. Accompanied by Mr. Pitt the Hospital, the two Institutions, the Duke and Mr. Pitt and the Agent Mr. Pitt made a complete survey of the several works and buildings of the Hospital found everything in the best order and the regularity of the works in the best order.

On his first Sunday in office he

Gave an order to the Plymouth Hospital and other officers to attend, George Pitt, and he gave them an order to attend. Gave an order to the Hospital to replace the regulations printed out in the Hospital.

On September 1 1795 there were appointed 104 patients to the Hospital although there were no more than 1000. Gave

error Cuyke was clearly impressed on their minds yet determined there should be no corruption.

I find it has been the custom of the Force to select women with first and experience for at least of two in the monthly list to the Admiralty. I've mentioned the previous, thinking that it cannot be proposed in the recovery of the salt to obtain a small supply of sea brine. I find this among the measures applied by the later day of the Government to the patients of the hospital and were given to the sea water, between the bridges — this has only placed in such abundant supply since June 1 1799, which it was asked for by Lord Howe and has been since continued.

This in my opinion though it is certainly proper if kept within and brought a no failure to obtain that there should be some efficient controls to remove the possibility of weight or improper method use of such valuable stores.

On September 1 1800 Clarke gave a very detailed account of the hospital, very matter in that given by Howard some years earlier but also containing some additional information on the establishments.

In the upper division of the Hospital ground on the houses and gardens of the Plymouth Hospital, several old Agents began them on the houses of the Navy, old Clerk and Agents Clerk and the Work House, and also the building system within the last years as on the left hand the Force's Lodge and the Agents' Office and the Reception and Hospital rooms. On the right hand the Clerk's rooms and the Hospital's Office and further on the Two Engine House commonly called the Dead House because corpses are removed there from the wards at about 10 noon, most specimens in the Dispensary and Medicine's Office. Besides these buildings there are the Engine House for forcing water up to the top of the different tanks, up to supply the water and the three-year for forcing a fresh water to cleanse the engine rooms.

Establishment on Plymouth Prison

On Wednesday September 14 Clarke as requested, climbed down on prison passage.

Given in order of the Medical Centre.

The date of Lord Howe's great victory with the French Fleet off the western coast of France.

was on the Establishment in response to the, the room for receiving patients from the sea and directed it to be shown to them all by Mr Bayle, Clerk of the Council.

There are several measures that England was then at war. The Hospital gate was dismantled in honour of Doctor's victory off Copenhagen and Nelson's victory of the Nile. We can only guess to what extent of health may from the fact that measles and sperm oil are the only substances mentioned in the journal. On Tuesday the order 19 1793 we may note the story.

Along the ship appeared for a general Thanksgiving for the success of the Fleet, headed by the Service in the Nile and Chopt.

A similar story appears in the following year. In answer to the petition of some women returned from a French prison to have ships raised in them as late as three days ago, the Governor was at first obliged to reply that none were available but their own clothes should be baked and purified.

He was however, too sympathetic with their plight to let the matter rest and 'wrote to the Admiralty representing the case and requesting some relief of them, with the necessary costs that each of them was supplied with an outfit at the public expense. There are many other stories there are the same sympathetic spirit — the full mark of the liberal governor.

The Nation of 1793

There are a number of milestones in time to arrest our attention such as this for December 14 1793.

On the request of the Port Agents and doctors, that I collect such by 1800 to establish meetings to select the bodies of the two members of the Admiralty who are ordered to be executed on board the *Marinesburg* in Plymouth Sound.

That year it will be remembered was notable for the eighteenth members in Sept.

land and the Navy. It seems that Plymouth has now selected as this entry for May 21 suggests.

The day the *Miner* arrived in the shops in the Barbican and the *W. & A. Purton* engaged to the *Comptroller* of the Hospital shop and they were declared to be open on the 22nd and 23rd respectively.

These matters are thought to have been partly due at least to the dissatisfaction of the women with the provisions supplied to them. Unsanitary goods were especially the direct consequence of the confusion between villainous purveyors and equally villainous Commissaries. No such vagaries can be detected in General Crofton entry after entry in his journal records his exposure of unsanitary goods, for example:

Examined the flour supplied the women and finding it was not nicely divided but rather lumpy should be immediately returned from the bakers as less all the grain is injured and the difference of price charged on the contract.

Undoubt the Governor expressed considerable profit in being able to record that

No symptoms of malady appeared among the patients in the Hospital.

Nevertheless further entries in his journal make it equally clear that mortal perils were by no means a rarity of any kind.

Feared men and Malingering

We must remember that this period was the height of the Prison panic when the Navy was accused by force and by conspiracy of the goods. There was certainly a lot of trouble of escape from a hospital like from a ship and it is hardly surprising that the women grasped any opportunity of escape that 'avoided death'. Disasters almost inevitably of prison men seem to have been of such common occurrence as to be regularly grouped with deaths and shipwrecks as the cause of disturbance at the hospital. It was because so many patients tended to desert

that a well-lit necessity to build the jail was well around the hospital perimeter and a prison guard not only at the gate but also at strategic points within the hospital. The one, however the Governor tells us that

Two women escaped away the night by means of a ladder left casually unlocked by one of them a short time in the month ending in a ship.

Harder it seems was not the only loss, patrol with drabs through which the patients might reveal to freedom (Page 1967).

John Williams escaped through the drain but was taken back to the Marine guard in the Harbor Road.

Malingering, too, was constantly noted as a species of engineering the desired discharge.

James Povey is reported to me as having got involved from this hospital by pretending, first at night, at a time reported that 'some who were involved in the last escape for captured the boat never had their names.

An even more interesting case is that which the Governor has reported in August 2, 1797.

A complaint was brought by one of the Agents Clerk of a quantity of criminals had been absent from the jail in one of the patients who was detained as wanted, it.

The next day he reported

Having traced out the woman who procured the escape of the ship of a Mr. Russell (Governor in Plymouth) and finding by on to the custody of that a person on the ship who was obviously making his escape attempt was enough exposed of being the person for whom the women's theories over the jail is it is estimated it probably a night and a night, the woman on the Major of Plymouth who ordered her to be detained for examination tomorrow.

The following day the matter was finally settled on.

Attended at the Court of to support the charges against Mrs. Wells who was charged with the escape of the woman on the ship previous of malingering out on a boat house near by Brixton, but only for

the purpose of restoring it after the flood to the sea, small provisions and I decided being found on the summit that the Mayanists climbed here into safety and remained here one week. On my return to the camp I discovered that the sea again was very dry and gradually it dry a good deal more fully, until his mother and hearing that he had spoken to the Wind that he had left the summit, he the advice of a Mahua who wrote down the order for the and I other articles of things were on his body that he might get released. I ordered him to be released on the safety still for his provisions and examined the Mahua who confessed to the wrong the order for the drugs, but denied my knowledge of the way they were intended for. Next morning we saw the men of being the advice and intention of the means provided at the camp to some other men and I knew in order to get released and I should have prosecuted him as further. I had not apprehended that it would first offend him to punishment that he died there with under being for price in a different and died a couple hours getting the cure of importance to me which he had recommended to him and others.

The Companion of Giovanni Cayula

Giovanni Cayula revealed himself as three moments as a man of companion as about two final questions arise. The first is in connection with the catastrophic explosion with great loss of life which occurred on board the *Dauphin* in 1790.

Wrote to a poor woman in Marseilles to inform her of the death of her son had to enter half a gallon, which she had sent for her son.

Wrote to the East Admiral requesting her to give Andrew Mathews, cook of the *Dauphin*, who is incapable of seeing further what he has to go to Spain and to recommend him to their Lordships as so well suited for service of the public department of a vessel on Government.

The Hospital Service coming under the Commissioner of Victualling after the peace of 1815, the Governor of the Royal Hospital Plymouth was also Resident Commissioner of the Victualling Board at Plymouth. Captain Richard Cayula here held both these appointments.



Fig. 1. View of Stonehouse Land, 1817. P. M. G. 1817. 1 (Old Stonehouse Land).
View of Stonehouse Land, 1817. P. M. G. 1817. 1 (Old Stonehouse Land).
View of Stonehouse Land, 1817. P. M. G. 1817. 1 (Old Stonehouse Land).

Old Stonehouse Land

A stone is a weathered stone. It is black a weathered Old Stonehouse Land (Fig. 1). This marks the corner of an old coast fort which is still in existence. There are reported references to supplies over the Stonehouse water supply at Cayula's point and for example on June 28, 1790, to water.

Mr. Pelly and several of the inhabitants of Stonehouse were in one such a case, sent them of the sufficiency of the supply of water to the inhabitants of the town from the fort which proved false and against the Warrent and requesting that an arrangement be made for the supply of water to the fort for the benefit of the inhabitants of Stonehouse and that I represented that I was partly living in the district of the town and partly in the fort being, several times Government, private relationship between the Warrent and the Board of Commissioners for the fort and appearing to the Committee that this was the way of the deficiency they left me with the declared manner of creating a bank against to be made for covering the water from the fort and across the fort to the fort, a deficiency was and a deficiency and I could be represented to present work of water. General Mordaunt referred to be charged for deficiencies.

A solution to the problem appears in a minute dated May 5, 1791.

Wrote to the R. G. W. M. his own opinion of the propriety of allowing the Duke of Devonshire to carry on the work of these pipes.

these the Hospital grounds provided no victory is due to the wall or grounds, and that they will continue to bring the value attached for the site of the Hospital by a time of years to the House of Commons.

A few days later he recorded the consent of the Board to these proposals.

The New Buildings on the Square, 1846.

While Governor Clayton sat out at Plymouth in 1795 only three official residences in backmark on the west side of the Square were then in being. That Clayton lost no time in trying to put the matter right is shown by an entry dated August 25, 1795: "has been done as follows:

Wrote to the S. & H. B. Co. on the subject of building residences for the new arrivals, and

After attending Divine Service on the following Sunday he launched a further broadcast:

August 31, 1795. Wrote to the Customs, about meeting place in the Chapel for the Governor and Lady, and about houses for their residence.

That he had not signed a day later was shown by the fact that 11 years had elapsed (1806) before the additional two were built, the splendid water cascades on the north and south sides of the Square were



Fig. 1. The Hospital, as it appeared in 1806, and as it appeared in 1846, and as it appeared in 1896.

Fig. 1. The Hospital, as it appeared in 1806, and as it appeared in 1846, and as it appeared in 1896.



Fig. 1. The Hospital, as it appeared in 1806, and as it appeared in 1846, and as it appeared in 1896.

Fig. 1. The Hospital, as it appeared in 1806, and as it appeared in 1846, and as it appeared in 1896.

erected (Fig. 4). There is no way of telling whether these substantial buildings have been designed by Daniel Algernon (1785-1848) the distinguished architect, who was for many years architect to the London Dock Company, and Trinity House, and designed the lighthouse at Harwich and Lady Island and the prisons at Dartmoor and Millstone. The main entrance gate to the Hospital Compound was also redesigned at this time, almost certainly by the same architect (Fig. 5). The simplicity of the design, the choice of the overhanging loop, and the mural boom supports, together with the excellent carriage, as noted by C. R. Smith, made the gateway of special concern to architects and engineers (Richardson and Gil, 1911).

The Establishment of the Naval Hospital.

It is of course useless to know the exact history of the Royal Naval Hospital at a period 400 years ago, 1606, at least as follows:

Before 1606	
1. Spring (Bathurst) 1606	1606 0 0
2. Spring (Bathurst) 1606	1606 0 0
3. Spring (Bathurst) 1606	1606 0 0
4. Spring (Bathurst) 1606	1606 0 0

category. Following 1970, it was destroyed at the Chatham Dockyard.

The Administration of the Royal Naval Hospital, Portsmouth

Captain Richard Aspley, who succeeded as Governor of the Hospital on December 1, 1870 by Captain Sir James A. Gordon RCB and who others remained in command for the next five and a half years. His Commission of Warranting upon received in 1842 the appointment was Technical Captain Superintendent of the Naval Personnel, 1 and and the holder of this appointment had charge of the Hospital until April 1870. There were in all 12 Captains Superintendents.

In April 1870 70 years of service in this name is an end when as a result of a report to the Civil Commission appointed to inquire into the conditions and requirements of naval hospitals the Captains and Lieutenants of naval hospitals were abolished



Fig. 11. Captain Superintendent R. P. Hoyle CB 1842-1870. The title was changed to the Surgeon General in 1870 and the rank to Surgeon General in 1875. The title of Surgeon General was abolished in 1911.



Fig. 12. Sir John L. Gordon RCB 1870-1871. The title was changed to the Surgeon General in 1870 and the rank to Surgeon General in 1875. The title of Surgeon General was abolished in 1911.

and the title of the Superintendent and the rank of the Surgeon General was changed upon the 1870 Commission. The first Surgeon General to be in charge of the Hospital was John Gordon CB MD who was appointed from 1870 until 1875. There followed 15 Surgeon-Generals (Fig. 12) until in 1911 the title was changed to Surgeon General and there were two of these. Since 1911 the hospital has been in the charge of a Surgeon Rear-Admiral (Fig. 13). There have been 74 such appointments, the usual tenure of office being three years.

After 19 of the Masters of the Royal Naval Hospital, Portsmouth will appear in the next number of the Journal.

THE WATERHOUSE-FRIDERICHSEN SYNDROME AND ITS ORTHOPAEDIC CONSEQUENCES

By Trevor R. W. Huxford and P. D. Gordon-Pugh

Synopsis

Two cases of fulminating meningococcal septicaemia with Waterhouse-Friderichsen syndrome are reported in young women. Both were recognized by peripheral purpura at unusual levels, which required the modification of standard surgical procedures to meet these individual requirements. The rationale of management is discussed in the light of the pathological processes involved, and cases are discussed on the basis of severity and impact on the same stage.

Introduction

The fulminating manifestation of meningococcal infection is acute bacterial meningitis. The least common although well known consequence of meningococcal infection is a fulminating septicaemia associated with profound shock, extensive purpura and a high early mortality and it is to this syndrome that Waterhouse and Friderichsen gave their names. Pathologically the striking feature of the syndrome has been widespread haemorrhages (Harrison, 1965) and particularly haemorrhagic necrosis of the adrenal glands (Mulliken, Kaganovi and Hays, 1967) leading to the supposition that the shock was manifestation of acute adrenal failure. Haemorrhagic manifestations have also been reported from many other sites (Morris, Cohen, Sakellides and Gennel, 1965) and the syndrome has been associated with subarachnoid haemorrhaging (Rothstein and Hall, 1969).

More recently cases of the syndrome associated with fulminating coagulopathy in

women (Block is no longer considered a case of adrenal destruction (Loren and Paster, 1968) but is considered to be an example of endotoxic shock (Zander and Fiedel, 1969). In addition it has become clear that disseminated intravascular coagulation occurs in many cases (Morris, Clark, Randall and Lubell, 1969; Winkler, von Sotgius, Cohn, Bertram and Wenz, 1969) and this may give rise to further haemorrhage as well as thrombotic manifestations by causing abrupt obstructions of bloodvessels thus producing a disseminated syndrome (Hicklin, Duffley, Macklin, Sanderson, Myers, Pappas and Webster, 1968).

Clinically a few minutes purpura, such a very common manifestation of septicaemia, might easily be missed even though these haemorrhages are seen in so-called purpura fulminans, and also sometimes in subcutaneous all areas of acute necrosis (Morris, 1965; Gilman, 1971). However it has appeared that such fulminating severe purpura carries a very grave prognosis and is almost a pathological event (Webster, *et al.* 1966) so it is not surprising that an severe purpura has rarely been described (Morris, 1965; Sakellides, 1965).

Clinical Reports

Case 1

The first patient was a 17-year-old Oxfordshire girl who was admitted at 11.00 on a Sunday. She had been well until the previous evening when she complained of malaise and shivering. After taking aspirin for sleep she had become very ill during the next morning, the subsequently occurred small quantities of skin haemorrhages being an early sign of infection.

On admission the central aspect of the face was cyanotic, conjunctivae pale and, during pulse, the a-



Fig. 1. Clinical photograph of the hands.

parallel with the back, like the feet, is said to be distributed proximally. The terminal phalanges of the index, middle and ring fingers of the right hand required extensive skin flaps. To her ill luck, all attempts at repeated attempts to save more tissue until a more than finger position to cut an ulcer on, of the left foot (Fig. 2a) is a recurrent ulcer, upper part of the right (Fig. 2b) is a description of all the legs (Fig. 3). Finally they failed from the first attempt, soon after the patient became a quadriplegic paraplegic in the right arm. After 1 year further walking (although the patient was able to have limited leg movement after all attempts with skin flaps and walking with a blocked chair.

CASE 2

The second patient was a 50-year-old IV who was admitted in 1950, also on a bed. He was paraplegic on a bed, paraplegic and had been treated with skin flaps, but was unable to walk after 1 year of treatment.



Fig. 2. Clinical photograph of the feet of the same patient.

and eventually, but otherwise had no specific symptoms. During the night he would swell up (swelling of skin flaps) in the morning he complained that his legs were weak and numb (in an ulcer area) in the morning he would have no response. During the course of the disease he began to develop the development of a dark purple rash on his hands.



Fig. 3. Clinical photograph of the lower leg and foot of the same patient.





FIG. 1.—Patient in the prone position.

On arrival he was in a state of marked distress. There was dyspnea, tachycardia, an profound shock, with considerable blood pressure, irregular radial pulse, and a heart rate of 160/min. The respiratory rate was 30/min., later rising hardly to 40/min. There was a tachypneal response out of the arms, hands and legs, which rapidly extended with constant signs of exhaustion (Fig. 1).

The clinical diagnosis was that of an anoxic syndrome with Minors's-Pedersen's syndrome and circulatory shock, with a definite reflex. Cerebral stimulation was given strictly in the anoxic and later intermittently. Intravenous hypotension was given at a initial rate of 70 mm. Hg. This was a not necessary to read the results of blood volume, but the peripheral blood film showed more pronounced morphological reactions, the changes were a moderate increase in

agglutination, 11,000/mm. and an leukocytosis of 15,000/mm. with plasma hyperproteinemia, 10.5 g./100 ml. (Fig. 2).

Blood volume was added to the anoxic state, but otherwise in addition to the established response, and by two hours a hypotensive blood pressure could be recorded at 70 mm. Hg, although pulse and respiratory rate remained very high. By four hours the blood pressure rose slowly to 100 mm. Hg, which represented a considerable improvement after the usual apparently marked anoxia. At the same time the radial pulse returned, but in the legs none could be felt below the popliteal vein. The blood pressure remained steady for the first two days, although it did not fall below 90 mm. Hg. The tachypneal response, and later profuse sweating, but otherwise the general progress remained satisfactory when digitalis dosage was about reduced and considerable relief was



FIG. 2.—Patient in the prone position, showing the effect of digitalis.

Ulna, the hypodermis had been removed, it became clear that there had been serious interference with the blood supply to both feet (Fig. 7). Once again it was decided that the possible benefits of hypars in this stage did not outweigh what was considered to be an serious hazards. Conservative management was therefore recommended as before.

Experiments on the dog were delayed 40 days after the onset of the illness. Whereas at the first postmortem study the feet had lost color and their normal flexibility, the extent of the damage at this second study was greater (Fig. 8). Major lesions were widespread and deep to most parts of some sections, especially on the volar surface of the forepaw digits. Thus the small muscles of both hands were badly affected in situ, as were cutaneous nerves in general difficult to accept (Fig. 9). The digits themselves were severely gangrenous to the extent that they were expected to separate before the legs were taken forward, while surprisingly, through an apparently healthy skin, a good circulation could not be maintained. This was associated but it proved possible to obtain satisfactory ulcers three days later.

The left leg, ankle and foot were also severely involved but most of the foot pad was still. On the sole of the foot the removal of all dead tissue which exposed all the bones of the foot is feasible, possibly in stages as far as the foot pad to the lower end of the tibia and ankle joint (Fig. 10) to the greater area, including all of which was exposed in 1 yr. due to direct contact to the cast the patient was left with 1 dorsal skin below knee during on the right and 1 very small residual 3 yrs.



Fig. 7. Forepaw of dog, 10 days after onset of illness. The digits are pale.

compared to on the left leg, all the toes were found to be gangrenous. There he was found to be similar procedure. Two months later the amputations exposed a "bad artery" and the patient is walking with legs 11 and 12.



Fig. 8. Forepaw of dog, 40 days after onset of illness. The digits are severely gangrenous.



Fig. 10. Forepaw of dog, 10 months after onset of illness. The foot pad is being removed in stages.



Fig. 1. Child with bilateral retrolental fibroplasia. (Courtesy of Dr. J. H. J. van der Meulen, Rotterdam.)



Fig. 2. Child with bilateral retrolental fibroplasia. (Courtesy of Dr. J. H. J. van der Meulen, Rotterdam.)

Blindness

The possible etiopathologic aspects of this grave illness are still uncertain. So far its etiology is considered too poorly known to treat as long as possible, since in no way can the determination to become quite clear and then correct all kind of visual impairing all visible data. It has, then, proved possible to obtain data, a week or so later light data quality have been used for guiding eye procedures and extremely in the area of the left eye of the second patient found an unfortunately very much in the present aspect of the first, even have adapted rather than carrying out operations previously. A child would need to kept for unexplained conditions, especially those affecting the upper limbs, and pre-emptive measures such as splinting and prevent movements mentioned.

There is no general agreement on the medical management of these cases of which there are only sporadic reports. However, proper management depends upon a knowledge of the present pathology and this has become clearer in recent years. In the first place it is often stated that the Waardenburg-Friderichsen syndrome is not the result of sudden bilateral detachment, were patients who recover have not been reported to show subsequent bilateral detachment and deaths have been reported after typical clinical courses with no permanent evidence of serious damage (Bridges, 1944). It is now generally accepted that the profound hypoplasia and coloboma in the Waardenburg-Friderichsen syndrome forms an example of retinoblastoma which is also seen in other types (Gardner and Jurell, 1949).

With regard to the prognosis there are two independent mechanisms at work. The first is the common vascular properties resulting from retinoblastoma damage to retinal vessels and particularly to capillaries, giving multiple capillary haemorrhages which show in the skin as a fine purpuric rash.

but also giving multiple local small vessel thromboses precipitated by the endothelial damage (Hall and Karmy, 1947).

This process does not account for the entire first and profound purpose taken over and there is now abundant evidence from laboratory studies (Abdelgawad, Chargin, Bender, Karmy, and Schulman, 1967; McDermott *et al.*, 1962; de Croux, 1969) and post-mortem findings (Horn *et al.*, 1959; Winklerstein *et al.*, 1959) that in these cases massive disseminated intravascular coagulation occurs independently of vascular damage. The episode started in this case is the generalized Shwartzman reaction, which has long been recognized although originally applied to an experimentally induced process (Horn and Rogers, 1953). In the clinical context however a circulating endotoxin initiates the coagulation response throughout the blood thus contributing to the thrombotic mechanism and resulting in widespread microvascular coagulation (Abdelgawad, 1969). The reaction depends upon a degree of stress in the vessel wall, which exists in the presence of shock, and it therefore occurs mainly in the small vessels.

The first result is, therefore, of mass from vascular occlusion. The second is a hemorrhagic shock due which results from the heavy consumption of fibrinogen. This is the, originally but, only named group (see map) (Dexter *et al.*, 1953). The Shwartzman reaction with this disseminated area of events has also been reported in unoperated (Horn, Rogers, and Imperato, 1954) and later (Wherry and Van Kesteren, 1963) and other experiments (Rosenzweig, Mason, Coburn, and Libon, 1959), as well as in acute infarction (Makley and Macpherson, 1957; Dedworth and Bates, 1959).

On this subject the situation may be considered. The general response may occur in the deepened pressure, with dis-

tributed regions and thromboses. The place of shock has been doubted (Child, 1961 *et al.*, 1967). It is however clear that because it is not necessarily impaired and actually because it is known that they are research on the intravascular coagulation of the Shwartzman reaction (Horn and Rogers, 1953). However there is no longer any doubt that shock has an essential part of the management of embolism shock (Horn, 1954; Juretic and Janoff, 1963; Wherry and Van Kesteren, 1963) and their secondary effect on in the presence of the vascular hemorrhagic shock described.

The place of heparin is less certain. It is clearly indicated on theoretical grounds in the presence of disseminated intravascular coagulation, firstly because it affects that process, and secondly, because it prevents the secondary coagulation of the, which results from it (Charles *et al.*, 1959). Given such enough it could perhaps prevent the venous gangrene shown in the present case and others. The dilemma, is to treat it heparin. That there is a serious hazard is that when it is given heparin that a vascular hemorrhage does show also (even in a high percentage of cases) and in these heparin might theoretically be disastrous. However it can be argued that sufficient experts will control the reaction. Perhaps therefore heparin and steroids and complementation, some heparin would in fact, counter the tendency of steroids to exacerbate the Shwartzman reaction (Horn *et al.*, 1954; Abdelgawad *et al.*, 1963).

Heparin would certainly have to be used in a very early stage, when the intravascular coagulation is in early and fulminating stage, and whose heparin has been successful in has been given early (Child, Bates and Shuttellard, 1958; Charles *et al.*, 1959) while where its value has been doubted it has been given after the coagulation has

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PATELLECTOMY FOR CHONDROMALACIA PATELLAE

By A. C. CHOLEMEYER

SUMMARY

Chondromalacia patellae presents a challenge to the orthopaedic surgeon, especially in the Naval Navy, where this condition is found to be very common. The results, from this condition after surgery, through the modification of the patella as a bone and not osteogenic, is suggest how to treat in an effective procedure. This paper discusses when other methods of treatment have failed. The overall results of patellectomy are good, but they also tend to be disappointing in the adolescent, viz. the Royal Marine recruits, which explains the surgeon's hesitation in performing total division of the patella in the young group of patients. The causes of the failure have been discussed. The overall results of patellectomy have been promising.

Introduction

According to Bennett, Weiss, and Bauer (1947) degeneration of the articular cartilage of the knee joint sets in at quite an early age and they have clearly shown that the superficial layer of the patellar articular cartilage shows some degenerative changes in very childhood above the age of 15 years. The articular cartilage of the patella is about double the thickness of that of the femoral and the tibial condyles, which may explain the vulnerability of the former to repeated trauma and repeated infection.

The first account of involvement of the articular surface of the patella by a degenerative process was given by Boudage (1904) but it was not until 1913 that the term chondromalacia was introduced by Adams.

The maximum incidence of this condition is in the young adult and the middle-aged and it is therefore not surprising that naval surgeons have to deal with a large number of patients suffering from chondromalacia patellae every year. Considering the nature, timing and severity such as is reported in the Naval Marines and the hundreds of soldiers and other difficult conditions associated with shipboard life in the Royal Navy, often persistent acute disabling symptoms of chondromalacia patellae in otherwise healthy individuals who would experience similar symptoms on a less strenuous occupation elsewhere. The way outside of the problem with chondromalacia patellae can be appreciated when the morbidity arising from the condition is taken into account. Records show that out of a total number of 5,677 new patients seen in the Orthopaedic Unit of the Royal Naval Hospital, Plymouth, in the last two years (1966-1971) no less than 345 suffered from chondromalacia patellae. It is certainly the commonest orthopaedic disorder involving acute traumatic conditions and has been previously diagnosed and treated in naval medical practice. Records at the Royal Naval Hospital, Plymouth also show that 465 patients, suffering from chondromalacia patellae were recruited from the Service in the last 12 years. These had been treated without operation or by a conservative type of procedure such as shaving of the patellar articular cartilage or medial femoral ridge osteotomy. In the same 12 years 14 patients were recruited having had patellectomy for chondromalacia.

In this survey an account is given of the results of pathotomy for chromosomal patches, and an attempt is made to show date some of the causes of the failure.

MATERIAL.

During the period under review (1955-1959) 113 pathotomies were performed for chromosomal patches on 184 patients at the Royal Naval Hospital, Plymouth. Table I shows the age incidence and the number of operations performed for various situations of the patch. It will be seen that roughly 70 per cent of the pathotomies were performed for chromosomal patches alone. Table II shows that 78 per cent of the patients who had pathotomy for chromosomal patches were aged between 14 and 50 years. There were no less than 14 cases just shy and these comprise the youngest patients in the series.

Table I
Age, situation and number of operations

Age group	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Chromosomal patches alone	1	1	1	1	1	1	1	1	1	1
Chromosomal patches with other lesions	1	1	1	1	1	1	1	1	1	1
Other lesions alone	1	1	1	1	1	1	1	1	1	1
Total	3	3	3	3	3	3	3	3	3	3

Note: Cases of chromosomal patches with other lesions are included in the total of pathotomies for chromosomal patches alone.

Table II
Age, size of patch and number of patches treated for chromosomal patches



It has not been possible to examine all the patients personally because not only had many left the Service when their engagement was had signed or when they were discharged, but also many were stationed overseas or were serving aboard shipping ships.

Altogether 20 patients (Group A) have been actually examined. These have data, two of follow up from 1-11 years, as shown in Table III. The table also includes 16 patients Group B, where post-operative progress could not be traced from the available, hospital, and one patient from outside.

Table III
Duration of follow up and number of cases

Mean about 40-45 follow up (3-4 yrs)				
Pathology interpretation as:				Significance
From other operations				
1-2 years	3-4 years	5-6 years	7-8 years	9-10 years
10	10	5	5	10
Group A				Group B

Diagnosis

About 40 per cent of the cases reached the onset of symptoms in a direct blow on the knee cap. In 15 out of 16 cases symptoms and signs of chromosomal patches developed after menorrhagia treated by laminectomy. Diagnosis was proved at autopsy on the strength of clinical findings, radiological confirmation being obtained in no more than a few cases.

Indications for Pathotomy

The indications are not clearly defined but all patients suffered from persistent pain localized to the pubic-ventral joint which failed to respond to conservative treatment. Again why pathotomy was preferred to other procedures cannot be explained easily. It is common knowledge that internal ear surgery may decide to treat the patch another way may

not do anything more than shave the affected area of venous coverage. Indeed the latter procedure has been carried out on a number of patients postdeficiency being reported in most instances at a later date for permanent disability. Medial forehead ridge collection (at Cambridge 1964 and 1966) was carried out on a few patients in the earlier years but the results were disappointing.

Technique and Post-Operative Progress

Postdeficiency was carried out through either a transverse or para-pibular incision. The latter was favoured whenever a thorough exploration of the gait was found to be necessary. These were only made as a guide to the correct technique which is the majority of cases surgical simple excisions followed by longitudinal repair of the quadriceps exposures without either overlap plastic or any form of tissue-plastic procedure.

Post-operative bed and rest, remained for about two weeks with the knee immobilised with a compressive bandage. Gentle quadriceps flexing and straight leg raising exercises were started 48 hours after operation. Most vigorous quadriceps holding exercises were instituted once the wound had usually healed, and knee flexion was allowed as soon as the time when the extensive leg had disappeared. The patient was allowed up straight legging with crutches as soon as knee flexion had reached 90°. After discharge from the hospital regular physiotherapy as an outpatient was considered an essential part of the treatment which was continued until the patient returned to full duty.

Post-Operative Complications

Early Complications

Phlebotomies

Table IV shows the incidence of haemorrhages in Group B patients of this series.

Post-operative pain was directly proportional to the amount of haemorrhages. Resumption of knee flexion was delayed in patients developing a moderate to severe degree of haemorrhages.

Table IV

Incidence of knee surface and postdeficiency haemorrhages

Group B	Haemorrhage + +	Large + + +
Number postdeficiency	Number postdeficiency	Number postdeficiency
15	2	4

Aspiration

Fortunately deep infections and septic arthritis were not encountered in this series. Superficial wound infection occurred in most patients but this did not seem to influence the outcome of postdeficiency.

Deep Vein Thromboses

Three patients had symptoms suggesting deep vein thrombosis in the calf in the operated side. Full recovery ensued in all of them.

Pulmonary Embolism

Only one patient a male aged 39 developed a mild attack of pulmonary embolism without any warning on the 10th post-operative day. He made an uneventful recovery.

Weakness of Quadriceps

A moderate degree of weakness was observed invariably in every patient immediately after the operation. The weakness was most pronounced in females, and in those patients where quadriceps was used to the maximal phase in postdeficiency. Table V shows the number of patients having an increase in leg after postdeficiency. The mean length of time for extensive leg to disappear was 22 days.

Table V

Extensor lag after participation
total scores (standard 40)

Length extensor after each session	Number who participated extensor lag
After first week	Not tested
less	14
more	11
less	11
more	1
N	37

Report of Quadriceps

This was not in a true sense a report. The verbal values late in the quadriceps expansion therapy dropped in many cases at the end. In each patient there was a history of the knee 'giving way', when walking without crutches was attempted and even about operations. Hystericalness and occurrence of extensor lag prevented expansion and recovery in these cases.

Leg Complications

Knee Swelling

The majority of patients did not experience any difficulty in regaining full knee flexion. The mean time for knee flexion to reach 90° was 19 days and for full flexion 73 days. Eight patients out of 44 in Group B required manipulation under general anaesthesia. Four patients were excluded from the Series because of post-operative stiffness of the knee following participation. In one of them no more than 20 flexion was achieved and the other three had only 31 flexion at the time of writing. The post-operative progress was complicated by hystericalness in all three last patients.

Quadriceps Atrophy

The power of the quadriceps was not tested with a dynamometer. Simple clinical measurements were used instead. Gradual loss of strength in the quadriceps was observed in the patients obtaining 'good' and 'fair' results, as described later in the

paper. Careful examination showed slight loss of power even in those obtaining excellent results, although the latter were not aware of their weakness.

New Knee Extension in the Flexion Bed

This subject will be discussed later in the paper.

RESULTS

The study has been conducted from a functional standpoint against a Service background. It should be emphasized here that the standard of treatment used is not at a higher level for servicemen. What is an excellent result for a civilian worker may not be so for a serviceman.

The results have been evaluated and classified 'excellent', 'good', 'fair' or 'poor' according to the criteria as shown in Table VI.

Table VI

Classification of Results

Result	Extensor lag	Quadriceps strength	Flexion	Swelling	Atrophy
Excellent	None	Good	90°	None	None
Good	Less than 10°	Good	90°	None	None
Fair	10°-20°	Good	90°	None	None
Poor	More than 20°	Good	90°	None	None
Excellent	None	Good	90°	None	None
Good	Less than 10°	Good	90°	None	None
Fair	10°-20°	Good	90°	None	None
Poor	More than 20°	Good	90°	None	None

Results of Results

In Table VII the results have been graded and expressed in terms of percentage. It will be seen that whereas in the short term follow-up series in Group B (the 16, minutes group) only 38.5 per cent of the patients obtained either 'good' or 'excellent' results in the long term follow-up series (Group A) the mean percentage of patients obtaining similar results rose to 85 per cent. This clearly indicates that about a quarter of the post-anaesthetic patients did not reach landing of improve

5. *New Bone Formation in the Pterial Bud* — A moderate to extensive degree of calcification in the pterial bud was revealed in eight of 12 out of 22 patients. All these 12 patients complained of joint stiffness and difficulty in working. The subject will be discussed at greater length later in the paper.

3. *State of Quadriceps prior to Pteralectomy* — No less than 13 out of 22 patients were noted to have a slight degree of wasting of quadriceps pre-operatively. In six patients, wasting of quadriceps was more than 2.5 cm. Here again the muscle wasting was at first partially attributable to prolonged conservative treatment.

8. *Mental Instability (Depressed or Frustrated)* — was present in three cases.

DISCUSSION

Historical Background

The history of pteryectomy dates back to 1860 the first attempt to perform this procedure being Peck, according to Murphy (1960).

In 1871 Fowler carried out pteryectomy for bilateral defects of the pteritis. Chapin (1891) recommended pteritis excision for correct old fractures and Stanton (1898) stated that partial and total pteryectomy did not involve loss of function because the quadriceps retained control of the leg through fibrous and bony connections. Scudder (1898) Tait (1900) Le Bonellier (1903) and Miller (1905) carried out pteryectomy for fractures. Tait thought that the importance of the pteritis had been over-estimated. Murphy (1960) who was also of the opinion that the pteritis was not essential for perfect mobility and function of the knee joint reasoned the long is two years of infirmity but Howard (1908) was the first to condemn the operation by making the remark that amputation of the pteritis was always a mistake. The latter, with others, had also pointed

out the some increased rigidity of the knee joint was present in every one of 53 cases of congenital absence of the pteritis. This was in sharp contrast to the findings of Loomis (1902) who had observed normal knee function in cases of congenital absence of the pteritis. However, strong evidence had the effect of damping down the enthusiasm of the then supporters of pteryectomy so much so that it almost fell in the province of the forgotten followed for quite a number of years.

Ludloff (1915) was the first surgeon to carry out pteryectomy for chronic arthritis and in 1931 Blodgett and Fairchild re-introduced pteryectomy in the treatment of fractures. The name of Blodgett (1931) (1937) is mentioned in almost all the literature on pteryectomy since he was the first person to popularize pteritis excision as a method of treatment of recent fractures by postulating that the pteritis subserved an important function and its removal gave rise to a limb which was functionally equal and in many cases superior to that of the normal or the unfractured limb. Brodie's revolutionary remark introduced a new era in the history of pteryectomy and this operation gathered a sudden momentum, receiving the support of Hey Groves (1932) Watson Jones (1934) and many others. Tipton (1937) Dodd (1938) Gordon and Kervin (1942) Harris and Lamborn (1944) Langford Wilson (1950), MacFarlane (1950) Van Rooy (1954) Peck (1962) and Adams and Miller (1962) for fractures. Bartholomew (1936) Haggart (1948) Allen (1949) Young and Ryan (1950) Harris (1950) Gordon (1953) (1955) Haldeman and Sullivan (1954) DeLorenz (1961) for chronic arthritis. Tibberg (1944) Koko-Shell (1945) Brandy (1957) Gray (1958) and De Nio and Hudson (1957) for chondrodystrophic pteritis. Tait (1956) McFarland (1948) and Koko-Shell for traumatic detachment of the pteritis.

Side by side with the increasing popularity of plasterfasciomy grew a cautious approach and warning with regard to the operative procedure, and consequently a wide development of systems developed concerning removal of the patella.

Brown and Wainwright (1947) from their experimental studies on rabbits observed no development of degenerative changes at the patellar surface of the femur and the tending was confirmed by Gossels (1949) and De Palma and Popen (1954) in their experimental studies. Cohen (1944) in similar studies on rabbits observed degenerative changes in the ilio-tibial articulation after plasterfasciomy. Thomson (1942) said that the patella, which was a separated bone, had no important functional value to the knee joint and he recommended preservation of one pole of the patella tupper or lower whenever possible.

Thomson (1945) studies on cadavers showed that the patella improved the efficiency of knee extension in the extended position of the joint by holding the patellar tendon away from the joint thereby, increasing the extending moment of the quadriceps joint and these experimental findings were confirmed by his own clinical investigations. Scott (1944) in his report on 104 plasterfasciomy found that only 5 per cent of the plasterfasciomy patients thought that their knee on the operated side was improved in the non-operated side. Routine resection of plasterfasciomy was condemned by Smith in 1951. Jansson (1955) was also of the opinion that the knee extension was certainly improved after removal of the patella. O'Donoghue, Thomson and Hays (1957) arrived at the conclusion that after plasterfasciomy there was an average loss of power of the quadriceps in complete extension by 79 per cent. McEwen (1955) believed that patellar prosthesis afforded better results than plasterfasciomy. Wood (1962) concluded that the subjective symptoms of

some weakness and quadriceps atrophy were common objective findings after plasterfasciomy. Jansson (1960) in his study of 69 cases of patellar fasciomy did not find any single indication for primary plasterfasciomy. Although Holmstrom and Nilsson (1954), Gecikler (1962) and others reported promising results of plasterfasciomy in osteoarthritis, Hoffman et al (1966) were not similarly convinced. Hougher (1955) reported good results of plasterfasciomy in the younger patients. The work of Islerle (1948) and Cawston et al (1964) showed that plasterfasciomy was a poor operation and did not deserve the reputation of Smith, Scott and other authors. On the other hand Biering (1970) based from his study of 42 patients that there was stability of quadriceps and only moderate elevation of patellofemoral joint after plasterfasciomy. He did not agree with Gecikler that an initial arrest of the chronic osteoarthritis program occurred after the operation.

Kander (1955) from his experimental work on fresh human cadaveric specimens related that the patella contributed to the knee extension moment arm through the energy gain of knee motion the contribution gradually increasing with progressive extension and this depending upon the technique of repair of the extensor mechanism after plasterfasciomy, full good plasterfasciomy extension required as much as 30 per cent increase in the quadriceps force, while may be beyond the scope of some patients.

Techniques

The literature shows a variety of techniques employed in the repair of the quadriceps mechanism after patellar resection. Hansen stressed the importance of restoring the quadriceps tendon in the patellar ligament as had been advocated by Probert (1940). Saxo Hall (1944) advocated transverse repair with 1.25 cm covering

to maintain the correct tension of the quadriceps. Horwitz recommended lateral plication to strengthen the slack in the quadriceps apparatus. Lloyd and Hurdston (1948) found it convenient to excise the two patellar ligaments separately after by passing the bone vertically with a saw. Sharpe and Davies (1959) designed a method of repair after patellectomy which involved taking an inverted Y-shaped flap from the quadriceps tendon and suturing the apex of the flap to the patellar ligament as an attempt to restore the central tendonous layer. Lewis and Hobson (1953) did not find any significant difference in the end results of patellectomy with varied operative techniques. Bennett (1964) emphasized the importance of the lateral expansion and contraction of the method of returning the quadriceps tendon to the patellar ligament. According to him such a method resulted in bunching up of the lateral expansions which had the effect of producing relative lengthening of the latter thus encouraging stiffness by post-operatively. He therefore supported the simple technique of excision of the patella through a vertical incision on the skin incision layer in front of the knee followed by approximation of the two lateral flaps to close the defect (disguished as pain). Lewis and Scholer (1970) claimed good results after crisscross repair of the anterior mechanism instead of the usual transverse or longitudinal repair. Chalmers (1969) praised Shook's method with only slight modification. A complete new concept in the literature was introduced by Kruger in 1971. He reduced tubercle palsy after patellectomy in a selected group of patients whose capacity to re-develop the quadriceps after the operation was markedly poor. A bone block was used to elevate the tibia inferiorly by 0.5 cm and then by displacing the anterior arch across anteriorly, increased the quadriceps

moment was thereby restoring the pulley action of the patella.

Experience gathered from the present series is in agreement with the views of Lewis and Sholman and Bennett in that variation of technique did not seem to affect the results of patellectomy. Longitudinal method of repair was therefore adopted whenever possible. The occurrence of adequate power in the quadriceps did not prove to be difficult in the majority of the cases because of their otherwise high standard of physical fitness and ready availability of the services of our expert physiotherapists and medical gymnasts. The question of tubercle palsy in conjunction with patellectomy therefore should rarely arise in the fit British patients.

Results compared with other cases

Until now, statistics are very few, but have been written about chondromalacia patellae in the Anglo-American literature if though the Scandinavian literature contained extensive reports of the condition by early authors—i.e. Olin (1904), Sellgren (1933), Karlson (1939), Wiberg (1940) etc.

The prevalence of chondromalacia patellae in British patients had been known for a long time. In 150 arthroscopies performed on subjects by Atkinson (1950) a total of softening and loosening of the articular surface of the patella was found in one third of the cases. Anderson (1949) from a naval hospital found 18 cases of chondromalacia patellae in 30 cases of arthroscopies. Kato (1941) from an army hospital found 12 cases in 65 arthroscopies. Carr, Kohn and Yeo (1965) again from an army hospital reported a number of cases of chondromalacia patellae. In 1946 Smith (23 Army) reported 18 cases of loosening of the articular cartilage of the patella in the young adult. In 1961 MacIntosh (Civilian

Table IX

Results of participation in chondromatous patella (continued)

Author	No. of patients	Result, patella	
		No. of patients	Percentage
Duke	10	Good	10
		Poor	0
Hatcherson	10	Good	10
		Poor	0
Delisle	10	Good	10
		Poor	0
Prangins	10	Good	10
		Poor	0
McGraw	10	Good	10
		Poor	0
Ward	10	Good	10
		Poor	0
Dwyer	10	Good	10
		Poor	0
Molnar	10	Good	10
		Poor	0

disposal. In 1952 published his pioneering short-term results of 40 cases of medial femoral ridge syndrome for chondromatous patella.

The published figures on the results of participation for chondromatous patella by various authors are shown in Table IX. In the series of Duke and Hatcherson the average age of the patient with poor results was 45.4 years and that with excellent results was 28.1 years. In the present series the results are strikingly different (see Table VIII). The discrepancy is mainly attributed to the fact that the series of Duke and Hatcherson included patients who had participated for fractures as well as chondromatous. Generally speaking results of participation for fractures are superior to those for chondromatous patella; for reasons which were not very clear.

The reasons for the poor group (14.32 years) forming the bulk of those choosing poor results cannot be explained easily. New bone formation in the patella had indeed occurred in a fair proportion of these patients but in others no apparent cause of the continuation of symptoms could be detected.

The following reasons are postulated:

1. The disease is often progressive in the young adult. Chondromatosis of the patella results of stress frequently accompanies patellar malacia.
2. The patients in this group being highly active do not readily accept the slight

weakness of quadriceps that it causes inevitably after participation.

3. Unfortunately poor motivation is weak. The Service tends to develop gradually in many patients. After many months of disability when the patella is eventually excised they begin to resent the Service conditions which they hold responsible for perpetuating their original symptoms of chondromatous patella. It is not surprising that these patients often exaggerate and use their post-operative disability as a means of escape from the Service.
4. Loss of a part of normal quadriceps sometimes is not well accepted by the relatively immature patient.

New Bone Formation in Patellar Bed

New bone formation in the patella had not infrequently preceded a problem after patellectomy. Prangins (1933) showed that the patella after excision could be regenerated in the form of either a bony or a cartilaginous structure which was regrowth of the excised bone physiologically. Curry, Zan and McGraw (1957) observed in young puppies the development of a mass of cartilage at the site where the cartilaginous patella had been removed, provided free joint movements were allowed. However regeneration did not take place when the bone was either removed or ankylosed. Hodges and Paschalis (1956) thought that the patella did not regenerate after excision but Molnar (1956) reported one case of complete regeneration of the patella after patellectomy. Delisle and Ryerson (1942) believed the regeneration probably took place restoring the protective function of the patella. Ward and Dwyer (1941) emphasized that the occurrence of pathological conditions after patellectomy had a definite disadvantage. This was corroborated by Duke and Hatcherson (1952) who wrote: Most of the patients with poor results had osteo-



Fig. 6. (a) and (b) are diagrams of the parotid gland and its parts. (a) shows the gland with its duct and the duct opening into the oral cavity. (b) shows the gland with its duct and the duct opening into the oral cavity.

test on the quadriceps tendon and this was marked as about two-thirds of three (66-66%).

As has been mentioned earlier, a moderate to a grave degree of calcification in the parotid body was revealed in this series as its first three 1/2 out of 12 patients who had been excluded from the biopsy after parathyroidectomy although complete regression in all of the parotid has not been encountered in this series. A repeated investigation was carried out into the incidence of new bone formation and its effect on the outcome of parathyroidectomy. Altogether 14 additional patients were radiologically examined and

Results

When parotidectomy was done, the results were as follows: the incidence of parathyroidectomy

Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5

Results were as follows: 100%

the results are shown in Table I. It can be inferred from these observations that there is a direct relationship between the satisfactory results from parathyroidectomy and new bone formation in the parotid body.

The latest experience in this series also shows that the first six months after parathyroidectomy is the crucial time when new bone formation may occur. At the present stage of our knowledge it is neither possible to predict which parathyroid patients will be affected by this condition after parathyroidectomy nor is there any known technique which will prevent the occurrence of this condition. Whether or not two negative responses in the early postoperative period have any direct bearing on the problem remains to be seen.



Fig. 7. (a) and (b) are radiographs of the parotid gland.

An Alternative Operation

In the recent months, psoas-pleuroplegomy, originally described by Gray and Brown (1958) has been carried out in a few patients for chondromatous psoitis. The initial results of this operation have been very encouraging. The technique (Figs 1 and 2) involves total removal of the psoas, its anterior sheath and shearing off of the psoitis, leaving the attachment of the quadriceps tendon and psoas ligament intact, the small remaining raw surface being covered by an inverted U-shaped flap raised from the infra-psoas fat pad, thus giving the anterior surface of the psoitis a similar the dermalis musculature. The long-term results of psoas-pleuroplegomy has yet to be seen and the author intends to carry out further research into this aspect in order to compare the results of psoas-tomy and psoas-plegomy.

There are various advantages of *psoas-plegomy* over *psoas-tomy*:

- 1 The protection and anatomic location of the psoas are preserved.
- 2 There is only minimal disturbance of the quadriceps mechanism, and the linkage action of the psoas is maintained.
- 3 A smooth anastomosis surface is presented for anastomosis with the psoas surface of the femur.
- 4 The possible psychological advantages to the patient for retaining the superficial visible part of the psoas cannot be ignored.
- 5 The puller effect of the psoas is not completely lost.
- 6 The new bone formation on the psoas bed which occurs frequently after psoas-tomy can be avoided with psoas-plegomy.

It has been claimed by Brooke that the psoas interferes in important function (as indicated Murphy's statement that one can assume like the kangaroo with

strong and strong quadriceps have no psoas). He, however, did not point out that the kangaroo unlike human beings has an enormous and powerful tail which is not only used for counterpoise, but also for transmission of a large proportion of its body weight both in rest and during propulsion.

CONCLUSIONS

- 1 Extending acute traumatic conditions and low back pain chondromatous psoitis is the commonest idiopathic disorder in Royal Naval medical practice.
- 2 Psoas-tomy is a simple procedure which when performed in properly selected cases produced long-term relief of symptoms and a good functional result.
- 3 The psoas has a useful function in the body. There is a varying degree of impairment of the strength of the quadriceps after psoas-tomy. Slight loss of quadriceps strength, although unperceptible to the patient, can be detected when in the group of patients who obtain excellent results.
- 4 Conservative treatment for chondromatous psoitis should not be prolonged, for in a large number of cases, the result is a significant loss of motor power from the Royal Navy.
- 5 Improvement after psoas-tomy is maintained for many months, certainly up to a year, at which stage an operation programme can be safely given. Once adequate knee function is restored and relief of regional symptoms obtained it is unusual for deterioration to occur in subsequent years.
- 6 It is suggested that further research, taking into account not only the problem of new bone formation on the psoas bed after psoas-tomy, which usually has an adverse effect on the outcome of the operation.

involvement removal of the parathyroid, the advocate is to be discouraged. Parathyroidectomy may well prove to be a better operation for this group of patients, as well as for females where a better cosmetic appearance is to be desired. Further studies to compare the results of parathyroid and parathyroidectomy for chondroblastoma parathyroid should be carried out.

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PATELLA CURTI — DEVELOPMENTAL OR TRAUMATIC?

By Eugene Mankowitz and F. D. Gordon Page

ABSTRACT

The radiological and operative findings in a case of patella curti are described. Films were available during the stage of ossification of the secondary epiphysis for the tip of the olecranon process which also showed a supplementary center in the region of the trochlea. The patella curti was formed in a fusion of all of these centers to form a corresponding defect in the tip of the olecranon. This confirms a developmental rather than a traumatic origin for this rare accessory bone.

Introduction

Patella curti is a rare accessory bone in the region of the olecranon process. The subject was first described by Knochel (1901) and subsequently by Pauly (1911) who reported that the lesion could be bilateral. Patella curti was reviewed in detail by Mankowitz (1952).

Our reason for reporting this case is that films are available during the formative stage of skeletal epiphyseal centers for the olecranon process and subsequent films are available showing the development of a patella curti.

Most of the discussion in previous papers has been centered around the congenital or traumatic origin of the lesion. Hilde (1942) believes that the lesion may be both congenital and traumatic in origin. Some of the cases which have been described as patella curti and illustrated as such appear to be those of an ununited fracture of the olecranon process. We feel that these patients should not be included. An ununited olecranon epiphysis should also be included.

Zurlo (1936) is strongly in favor of a traumatic origin in which separation of the epiphyseal center for the olecranon in early childhood is aggravated by the muscular pull of the triceps tendon. He traced the lesion to the Latham injury resulting from the detachment of the secondary epiphysis for the medial epicondyle of the humerus. Hilde (1942) suggested that a persistent separation of the epiphysis was the cause but he also discussed a case with the typical wide deep patella curti plus a fracture of the olecranon process. Hilde (1942) believes that the present evidence is against the factor of trauma.

Kramer (1931) believes that ossification occurs in the trochlea tendon forming a true ununited and that trauma may be excluded when the olecranon process is intact. He was not prepared to exclude the possibility of an indirect injury in some cases but excluded injury in his own case and believes the condition to be a true congenital anomaly. Rosand (1932) agreed with the theory of a congenital anomaly and considered the structure to be a true ossified which at operation was found to be covered by a genuine hyaline cartilage coating. Pauly (1911) believes patella curti to be an ossification of the tendon and not a ununited. The olecranon is often considered from two epiphyseal centers. His theory was that the uppermost center becomes detached by pull from the triceps tendon and on larger to form the patella curti. He was up to the theory of direct trauma as he was which showed a bilateral lesion had had no trauma to one elbow. The triceps

tendon is not attached to the prox. end of the olecranon but on the dorsal portion of the body of the bone. Sometimes a shelf at the olecranon represents a union site in the development of a true osseous bone patella cubitus (Köhler & Ziemer 1984).

Köhler and Dapkenien (1944) observed that the combined measurement of the elbow joint the olecranon was greater than the opposite normal elbow. Lyons (1950) describing a fracture through a patella cubitus fracture, the theory that the shortest patella cubitus arises at the vertex of an acute angle rather than from a previously separated epiphyseal nucleus.

Case Report

A male development worker aged 25 years, played at night volleyball, occurred moderate discomfort in, and the abnormal appearance of his left elbow. The elbow had first troubled him four years previously when he landed it against a bus seat. At this time he had been referred to another hospital where a had been noted that the olecranon bone was swollen and there was a lump, which seemed as a cartilage mass in X-ray palpably within the triceps tendon. He had been treated for a few days by a pod and bandage and after his arm he often had severe bone pain.

On examination a large lump about the size of a golf ball was both visible and palpable immediately proximal to the superior aspect of the olecranon. It appeared to be within the substance of the triceps tendon. Elbow movements were full but the patient is clumsy on the left was a little slower on that on the right.

The normal X-ray films were obtained and found to show an epiphyseal centre at the normal site on the superior aspect of the olecranon together with a radiopaque united site in the region of the olecranon bone. There was some soft tissue swelling

but no fracture or displacement of the epiphysis was demonstrated in the region since there was a well-marked patella cubitus which was now completely ossified. The upper epiphysis of the ulna seemed to have become part of the patella cubitus.

An operation the patella cubitus was found within the substance of the triceps tendon which still was united mainly into the posterior aspect and partly into the lateral aspects of the olecranon. The patella cubitus articulates with the superior aspect of the olecranon and the posterior aspect of the lower end of the humerus. All the relevant articular surfaces showed fairly advanced degenerative changes. The patella cubitus was excised out and the continuity of the triceps tendon preserved. The dimensions of the patella cubitus were 4.5 centimeters in length by 2.9 centimeters in breadth by 1.0 centimeters in depth.

The patient made an uninterrupted recovery. Two months after operation he had regained virtually full movements and power was symptom free and well placed.

Radiological Features

The typical appearance of a fully developed patella cubitus can be seen in this patient (Fig. 1) with a large well-shaped bony mass lying proximal to the olecranon process in the triceps tendon. Comparison with the opposite normal olecranon process shows two significant features: at distance to the distal bony mass of the middle of the olecranon process plus the ossified patella cubitus and secondly a defect of bone on the superior and posterior aspects of the wing of the olecranon (Fig. 2). In cases of pure trauma, such as a fracture of the olecranon or separation of the epiphysis we would expect the distal bony mass to be equal to the opposite normal side.

The initial film, taken at the age of 16



Fig. 1. Root canal filling in a 1955 board MA.
A 1970 board MA.

which shows two large apical centers at the top of the cleavage process (Fig. 1). The distal apical center is close and parallel to the normal secondary crest for the top of the cleavage process. This apical center develops between the ages of 10 and 13 years, often from two or three conic centers. Schwartz (1957) but each double center lies within the area finally occupied by the normal apical plate.



Fig. 2. Root canal filling in a 1955 board MA.
A 1970 board MA.

and first to form a single apical center by the age of 14 years. The larger of the two centers lies proximal to the normal one of the apical plate and can therefore be accepted as being a marginal upper secondary center. Careful inspection of the erupted line shows that a small plate apical center is present on the parieto-lateral margin of the body of the cleavage (Fig. 3a and 3b). The fully developed postincisive has been formed by a fusion of the large representative inside the main apical center and the small conic-like center on the posterior surface of the cleavage. The pulp of the incisor, which has helped to detach the apical center. This explains the final position of the defect of bone on the superior and posterior margin of the cleavage process.



Fig. 3. Stages of radiographs in 1955 board MA and 1970 board MA.

(a) Root canal filling in a 1955 board MA. (b) Root canal filling in a 1970 board MA. (c) Root canal filling in a 1955 board MA. (d) Root canal filling in a 1970 board MA.

1. The root canal filling in a 1955 board MA. 2. The root canal filling in a 1970 board MA.

3. The root canal filling in a 1955 board MA. 4. The root canal filling in a 1970 board MA.

5. The root canal filling in a 1955 board MA. 6. The root canal filling in a 1970 board MA.

7. The root canal filling in a 1955 board MA. 8. The root canal filling in a 1970 board MA.



Fig. 1. (a) Coronal section of the brain of a 10-day-old mouse. (b) Sagittal section of the brain of a 10-day-old mouse.

Pathology of the brain

We are most grateful to Dr H. A. Brown of the Medical Anatomy Department, The Royal National Orthopaedic Hospital, London, for his examination of this specimen. He made a longitudinal section of the specimen as illustrated in Fig. 1 to show the diameter of the abnormal mass of bone. He reported that it appeared to be made up of quite normal lamellar bone without any indication of disunion, and different parts. He stated that all the evidence in this case is consistent with the lesion being developmental. The specimen is now in the collection of the Institute of Orthopaedics.

Discussion

Kienbock (1933) and Pearly (1933) have both described bilateral examples of parietal lobes which support a congenital rather than a traumatic origin. Since patients have presented themselves for the first time following minor injuries to the skull, the clinical examination reveals the prominent bone in the region of the clearance which is freely movable in the transverse section. There is lack of any lesion

seen on inspection or single or repeated tomographic sections.

In contrast with Kienbock (1933) we were able to confirm at operation that the bone with the superior aspect of the clearance stump and the posterior aspect of the lower end of the bone was and that the parietal lobes lay embedded in the transverse section.

Kienbock (1933) in his original description mentioned that at operation for removal of the parietal lobes the clearance appeared to be intact but a careful inspection of the radiograph shows that there is a defect at the end of stump of the secondary epiphysis for the clearance. A similar observation can be made in other illustrated radiographs showing a typical parietal lobes.

The histological discovery of the lesion at the tip of the parietal lobes is in support of the basic concept of Pearly (1933) of separation of the secondary epiphysis for the clearance by the pull of the transverse section. This view amplifies his theory but shows the separation of a separation of part of the secondary epiphysis which value epiphyseal ridges. The whole plate of the epiphysis plus the transverse parietal epiphysis plate becomes incorporated with main epiphysis. This posterior epiphyseal plate has not been described previously and explains both the overlap by the tip of the parietal lobes and the posterior defect in the clearance stump.

Finally our experience suggests that a parietal lobes can be safely removed from a patient in whom degenerative changes have given rise to symptoms.

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THE SIGNIFICANCE OF FUNGAL GROWTH IN NUCLEAR SUBMARINES

R. J. Davis, M. G. Harper and J. E. W. Morris

SUMMARY

The visible presence of fungal growth in certain areas of nuclear submarines has given rise to concern amongst the crew. The airborne spore population was investigated to determine the medical significance of such growth and the methods used are described. It is concluded that no medical hazards are associated with the presence of fungal growth, but that action is necessary to deal with the material deterioration caused by the growth. The overall investigation is a good example of how medical, technical and engineering staff within the Ministry of Defence (Pentagon) work closely together to resolve such problems in nuclear vessels.

Introduction

Fungal contamination was first recorded by Samuel Papp, who wrote in his diary that moulds as big as footballs had been reported in HM Ships. He pointed this out as potential evidence of the squaker (as found on the wingtips of his nose rather than as a specific threat to the health of the cabin). During more recent years both medical interest appears to have been taken as long as the advent of the nuclear submarine with its closed environment. The presence of fungi in nuclear submarines was first reported in 1966 by HMS Porpoise. Since then all submarines have reported varying degrees of fungal contamination, mostly in areas of high condensation. The fungi often favour the high relative humidity especially on chilled water supplies, water penetrations, through the hullbars and deckhead penetrations. In

particular the tenders at the sea, supplying systems are heavily contaminated, producing an estimated 500g of white/green slush fungus in a two month period. In one instance this slush blocked the scuppers and caused flooding in the compartments. The fungi are able to utilize any hydrocarbon for growth by producing appropriate enzymes and in this way can colonize oil covered surfaces, petroleum condensates and the chemical gasdriers used for removing hydrocarbon contaminants from the atmosphere.

The more common genera causing visible growth on surfaces were found to be *Fusarium*, *Chaetomium* and *Cephalosporium*. But a wide variety of species of *Fusarium*, *Blasaria*, *Aspergillus* and *Phoma* have also been isolated. Gairdner (1970) reporting on samples from HM Submarines Porpoise and Endeavour concluded that none of the species isolated were recognized pathogens and no common saprophytes or commensals were not isolated in the spite of susceptible habitats.



Fig 1. Growth of fungus on wall of compartment.

It has been found during routine haematological examinations on surface waterfishes exhibiting regular periods that about 40-65 per cent of these men have blood mononuclear counts in excess of 500 per cubic millimetre. The high counts are most frequent in post-partur surveys and are less frequent in a similar group of fish who were not exhibiting regular periods (Morris, 1971). The normal mononuclear count is usually stated to be 1-4 per cent of the total leukocyte count which yields an absolute figure of 150-400 per cubic millimetre (Whitely and Bustin, 1969). Decker (1946) found that not more than 1 per cent of normal subjects have an mononuclear count of more than 540 per cubic millimetre and this was later confirmed by Morikubo, Lohr and Kish (1972). The mononuclear count in leishs is, however, subject to considerable diurnal variation, the lowest counts being found in the morning (400-500) and the highest at night (800 to 9400) (Morris and Mills, 1970). The blood counts on salmonines were carried out between 0800 and 1200 in the time when they could have been expected to be at their lowest level. However, many of the subjects were weak, keeping and it is not possible to state exactly what influence disturbance of diurnal rhythms had on these mononuclear counts. Eosinophilia is of course well known in all types of leishs and about 50 per cent of all all-type parasites show a blood eosinophilia ranging from 10 to 50 per cent of the total leukocytes (Morikubo and Holstad, 1970). Because some of the counts were on the same and because there appeared to be a red, flat surface underneath might become scratched through exposure to high concentrations of animal spirits in the air, an investigation to increase the all-type spirit population in order to decrease any residual spirit count of these leishs concentrations was carried out.

Methods and Materials

The investigations were carried out by the following work groups co-ordinated by the Submarine Medical Section, Institute of Naval Medicine:

1. Medical Officers of HMS *Porpoise* and HMS *Porpoise* who collected the samples and covered the colonies after initial incubation.
2. Microbiological Section, Admiralty Materials Laboratory, staff who confirmed the identification of the animal species, and carried out work to estimate the material decomposition percentage.
3. Submarine Medical Section, Institute of Naval Medicine, who supplied the equipment, trained the medical staff involved and analysed the results.

Studies at HMS 'Porpoise'

a. Fresh water leishs (fresh water leishs)

The experiment used was a modified version of the all sample described by Horowitz, Lohr and Thomas (1960). Five minute samples were taken at a constant rate of 10 litres per minute and delivered on plates of steel agar freshly prepared on board the submarine. Samples were collected from weekly during an eight week period from five positions in the ship, combined at 20-25 °C for five days and the resultant colonies counted. The plates were subsequently stored at 4 °C for check counts and identification of genera at the end of the period.

b. Total water leishs (total water leishs)

The sampler used was the Cribble cassette impinger designed for sampling airborne particles in bore air samples from 200 to 65 metres. It consists of a system of four jets impinging on water in glass dishes which are previously coated with a film of paraffin jelly. The jets are pre-viously fixed so that the spirit surfaces from jet to jet when air is drawn through

at a steady rate. Samples were collected at a sampling rate of 20 litres per minute for three minutes before the glass door was removed, covered with a glass cover slip and sealed for microscopic examination in the laboratory at the end of the period.

Sampling for total spores was carried out twice weekly from five places on the ship during an eight week period and also five hourly at the Foster-Riesch-Riesch Space during two 24 hour periods on day 3 and day 40 of the period.

Studies in HMS *Revenge*

When it became evident that the surveys on HMS *Argo* would show few results the study was extended to the next point of HMS *Revenge*, another ship in which large counts of fungi had been reported in wing tubes, and other places. Six samples came from unknown viable fungal spores were collected as above but the sampling time was extended to ten minutes at 20 litres air per minute and samples were collected at the Bulk Head every four hours on each of days 6, 30 and 40 of the period.

Total airborne fungal spore counts were collected on glass fibre in the Canella cascade impactor sampling for 5 minutes at 40 litres per minute every four hours on days 6, 10 and 40 of the period.

Results

1. Viable fungal spore counts

The results of the surveys for viable fungal spores in the air of the two rich marine Antarctic and Revenge are shown in Fig. 7 as the number of colonies per unit air sample after 3 days incubation. These results were checked in the days when they at the end of the respective periods when regular results were obtained.

The counts are generally low and the highest recorded outside the Antarctic Midway Space on Day 2 correspond to less than 2 organisms per cubic foot of

FIGURE 7. Viable fungal spore counts from air in Revenge.



Fig. 7.

air (approx. $\times 1581/m^3$). The results on this ship can be expected to be higher than elsewhere since the ship is shut down when the compartments above it are fired apart for air drawn from all other compartments, part of which passes directly to HMS 1/2. In addition there is a large number of dried waste paper with poor wet condensation occurring at these two areas. Nevertheless, despite the presence of these particles in the vicinity the airborne counts are not high, ranging from nil to 804 per 100 litre sample and at the highest level this corresponds to 12 spores cm^{-3} or $10^{10}/m^3$.

2. Total fungal spore counts

These were misreading. Of the 10% ground glass doors from only 9% air samples taken in *Argo* had any indication of the usual black tint along the rim of the air impact as it passes through the sampler. Most of these that had this indication were taken in the pre-paired period when the ship was open to atmosphere. This suggested that either the accelerated air in the dried submarine had very fine particles or that the glass door had not been prepared with a sufficient coating of potassium pills.

Subsequently the doors used in *Revenge* were more thickly coated but the results

were essentially the same. A detailed microscopic examination of the discs from each of the four stages of 30 samples from *Aspelle* and 18 samples from *Arreaga* showed that the microclimate in the dried tubers was substantially less than dust alone and other particles and appears to be closer than in a clean laboratory. The highest fungal spore counts recorded during this microscopic survey were between 20 and 34 on a total of the discs from the two intermediate run stages of the *Casilla* exposure and with a total air flow of 100 litres these correspond to spore counts of 200-340 spores/m³. Most of the discs examined were a factor of 10 lower than this, and a number of the other samples was not profiled.

3. Types of fungi isolated

Laboratory identification of the genera of the fungal colonies recovered is shown in Table 1.

Table 1
TYPES OF FUNGI FOUND IN EXPOSURE ARE

Results obtained for a fungal survey in 1967/68 (1974/5) at 1000/5 (1974/5) 1000	
Species	% of total spores isolated (each time)
<i>Penicillium</i> species	32%
<i>Dematiaceae</i> species	15%
<i>Aspergillus</i> species	1%
<i>Trich</i>	1%
<i>Sphaeroglyphus</i> species	1%
<i>Puccinia</i> species	1%

No attempt was made to identify most of the species and as can be seen from Table 1 about 95 per cent of the total strains recovered were various species of *Penicillium*. *Aspergillus* species are known to grow slowly in man and of the strains strains isolated two from *Aspelle* and one from *Arreaga* were identified as *Aspergillus niger*. One intermediate being *Aspergillus terreus*.

Discussion

The results show that the run in the two *Polars*, submarines, was maintained on a highly satisfactory state with respect to the presence of particulate matter and fungal elements. Despite the growth of clasts of fungus in some areas of the ship it seems unlikely that fungal spores are widely disseminated or that if they are, then they are rapidly removed by the ship's air purification system. This is similar to observations made on airborne bacteria levels (Morris, Lambert, Carlsbush and Dixon 1965) where despite the generation of aerosols from released venting of sewage tanks the submarine atmosphere remains generally free from gross bacterial contamination.

There is a single run in the viable fungal spore count as the revealment is compared with that when the ship is open to atmosphere and this run is also seen in the number of airborne bacteria. The fungi however are obviously associated with human activity and are lower in the less occupied machinery spaces whereas the fungal spore counts are higher in these areas. Airborne bacteria levels were higher in the evening when the crew were changing and taking part in maintenance but there is no clear time of day effect on the fungal spore counts.

Maloney (1964) also studied the fungal flora of the submarine environment during a period by a US Navy Polaris submarine. His results are not strictly comparable to those presented here since he used settle plates and these are liable to give a false picture in situations where there is a forced circulation of air. He stated that the numbers of airborne fungi are markedly reduced during a submerged period and concluded that this reduction was due to their removal by the air recirculation equipment. He also noted that the relative numbers of *Penicillium* and yeasts dropped during the period with the former pre-

PROBLEM DRINKING¹

By Harold H. Siegel

ABSTRACT

Problem drinking is relatively common on the Royal Navy, but can be linked in many cases to recognized stress. The drinking patterns and social consequences of problem drinking are discussed and symptoms of alcohol dependence are described. Cases fall into early established and late groups and diagnostic features are discussed.

Definition

A problem drinker is one caused by regular or repeated excessive consumption of alcohol.

Development of Addiction

Alcohol is a drug of addiction which gives a high and induces euphoria in some circumstances or a high feeling or tolerance develops a larger quantity is needed for the same high and as tolerance increases symptoms of withdrawal occur with abstinence. It was then he used that dependence has occurred. These features lead to the drink being consumed habitually.

Drugs

Alcohol is a drug and its effect is dose-related. Both experiment and experience strongly suggest that by the time the drinker is taking a bottle of spirits a day or its equivalent in other beverages, he has a serious drinking problem. In quantitative terms this dangerous daily dose is 250 grams of alcohol, a day.

TABLE 1

Type of beverage	Alcohol content in 100 ml (grams)
1 bottle of spirits	125 gm
2 bottles of cheap or cheaper than that wine	125 gm
1½ bottles of wine	125 gm
30 pints strong beer	125 gm
40 pints weak beer (Pilsener)	125 gm
14 pints stout beer	125 gm

While the problem drinker may not readily admit his true drinking habits, the questionnaire system might discover his pattern and direct reliable information of his consumption to a problem state. For instance of a person a drinking VP (Vogel) type score or result tells he is probably trying to get the best value for money and of substance, but his drinking is getting out of hand.

The questionnaire on page 129 enables the reader to gauge of alcohol alcohol, to be roughly calculated.

Drinking Patterns

Experience suggests that there are two patterns of drinking in the Royal Navy.

The Binge. During the evenings of a run ashore at first night or the dose of alcohol is often consumed or six to eight hours and great intoxication is common. Such individuals are unable to control their drinking and thus reduce the best maintenance of the large loss of



Fig. 1. Mean of drinking volume (glasses per day) and standard error for 100 subjects over 100 days. The data were used in the study.

Source: Adapted from *Journal of Alcoholism Research*, 1973, 12, 129-130.

control. Once this ends, they reveal an ability to abstain often used to refute the possibility of a drinking problem or that the individual is an alcoholic. So, there is further from the truth. The majority of members of Alcoholics Anonymous share the position of drinking.

Typing. By this is implied a steady state of alcohol throughout the day. At least in the early stages there is no loss of control, but if the typist abstinence develops, withdrawal symptoms and recurrent drinking. In other words, there is instability in abstinence.

Social Aspects of Problem Drinking

Domesticity. Service or home life with a drinking problem can be difficult because of intolerance. As problem drinking progresses there is a change in emotions. This can result in social and family problems and moral difficulties and disciplinary actions. In prison and treatment, an often trait in the Service men that a third of officers punished by courts are alcohol related (Murray, 1973). A similar percentage of men in civil courts apart from changes of couple domesticity. Drinking

alcohol (drinking) is often associated with domestic problems, particularly in the older men.

Debt. The expense of heavy drinking adds to the burden, particularly for the married man. Only the family accepts a limited standard of living or debt. Even the single man has to borrow from pay day to pay day and cannot meet his debt. With increased stress on alcohol he begins to look for the low key or other words, the more physical for the least money. British-type limited money or rough order (simplicity) and otherwise, chronic.

Domestic Problems. The drinking of the husband is likely to determine as his drinking continues not only a more domestic life is needed or limited due to financial difficulties, but there are more specific difficulties.

A particular form of instability develops leading to physical violence towards the spouse, children and domestic possessions. There is, also a failure of sexual performance combined with impotence and avoidance of the spouse's fidelity resulting in domestic stress and family disruption. Often the family breaks up. Sometimes the drinking partner blames his spouse and seeks another one. This process may repeat itself.

Depression and Anxiety. The drinker may suffer acute spells of depression and anxiety and may receive treatment from his doctor. Not infrequently self-poisoning can occur and is attributed to the domestic stress rather than to some problem drinking.

Marked mood changes of depression, melancholy and anxiety are often given as the reason for heavy drinking but the drinking usually precedes serious mood changes. A violent table is usually linked if depression leads to further drinking.

The Syndrome of Alcohol-Dependence

Alcohol is a drug that causes physical dependence. Once the organism has acquired the cerebral drive for the cerebral period abstinence withdrawal brings about the abstinence syndrome.

There are seven symptom groups of the alcohol abstinence syndrome of which the most common are groups 1-4.

1. **The tremulous reaction.** This occurs within eight hours of abstinence and is manifested by the tremulous shiver. It is first noticed when sleep and is associated with increased morning nausea and vomiting, or both, both hours.
2. **Anxiety, tremor.** The so-called blackouts of alcoholism are an early sign of problem drinking and usually occur at the end of a day's binge, or more commonly in the early part when up. The anxiety which includes the later stages of a binge may be a form of vegetative anxiety and in that state the drinker cannot and apparently cannot control including conversation but is unable subsequently to recall such events.
3. **Sleep disturbance.** Alcohol is a hypnotic and as when it is missed drinking is increased and may take the form of nightmares.
4. **Anxiety and depression** caused by agitation and beta waves.
5. **Delirium.** is usually found and often associated with oral hyperemia. The drinking state begins through into waking time.
6. **Delirium.**
7. **Full**—present and in type usually in the first 18 hours after ending a binge or following abstinence.

The longer the episode of drinking and the greater the amount taken, the more likely are hallucinations, delirium and fits. The combination of these symptoms groups gives rise to the classic picture of alcoholism but visual hallucinations are more common and so-called atypical reactions occur more often than delirium tremens.

Diseases associated with Problem Drinking

Apart from the abstinence syndrome a variety of other diseases can occur in the alcoholic. These various diseases have liver damage especially cardiomyopathy, pancreatitis, peptic ulcer, hemorrhoids, osteomyelitis and hypoglycemia. The presence of any of these should lead to the consideration of a drinking problem.

Diagnosis of Problem Drinking

Conditions are only diagnosed if they are known to the physician and are not inferred or left unobserved diagnosis. In addition to physical examination and investigation other sources may give clues such as personal medical diagnosis, home SNA within past 24 hours of the patient's admission and diagnosis, or past diagnosis, spouse and relatives.

Early Symptoms

There are, namely those of developing tolerance and of increasing addiction with withdrawal symptoms. Complications are not recognized at this stage. Diagnosis may be assisted by such factors as making promises or resolutions about drinking, maintaining or lying about the amount of drinking, gulping drinks in order to get a sufficient dose, to give a back-pulling ahead of the group or having a drink before going to a compulsory drinking or not when adhering to a fixed drinking schedule in spite of circumstances, many events, as tragedy, for drinking drinking.

an usually inappropriate concern: being alcohol is a staple pick me up, needing a drink to steady the nerves every alcohol is a target warrior, or to get rid of depression, requiring alcohol to be able to get right on going someone and feel like other people, someone blackman and even social drinkers.

Established symptoms

The previous symptoms are intensified and the signs of the alcoholism symptoms are increasingly in evidence. The patient may make frequent promises to stop or control his drinking, but shows signs of his drinking and drinking behavior and use all kinds of subterfuge to get enough to drink even on social occasions. He needs alcohol constantly to back him up or to calm him down while depression leads to his a constant companion. He is plagued by nervous and fears, is obviously concerned at times, frequent pain and then rather than recovery leads and takes to drinking alone. Drinking comes to some help, such a morning drink needed to get rid of nervous nervous and alcohol his becomes unstable and leave it short of alcohol or temporarily on the way, has difficulty in talking about drink and try to live. There are marked feelings of guilt for extensive drinking and control on. There may be gulping or rapid drinking to get the kick due to let strong tolerance and this also leads to rapid intoxication. The true extent of drink being concealed. Severe hangovers occur and there is loss of time from work. Drink cuts and pain cuts are more frequent.

Risk symptoms

The previous signs are exaggerated and the patient is often drunk at work. He drinks throughout the day and there is marked emotional instability with extreme personal response, particularly anxiety and irritability. His working efficiency declines, he shows his family and has severe financial problems.

Conclusion

It will be apparent that the same alcoholism and alcoholic has been largely avoided in this paper. This is deliberate. The image of the alcoholic is so stereotyped that to use the term problem drinker and problem drinkers should point a fresh look at these phenomena.

Problem drinking is common in the Royal Navy and it may affect 5 per cent of serving personnel. The problem is often progressively but the process can be halted in many cases if the situation is recognized in time. A positive preventive effort is needed.

Acknowledgment

It is a pleasure to acknowledge by kind permission the advice (March 1978) and the advice (March 1978) of the author.

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REPORT OF THE WHALE ISLAND HEARING CONSERVATION PROGRAMME FOR THE GUNNERY BRANCH OF THE ROYAL NAVY

By P. F. Teal

ABSTRACT

An audiotaping survey of Seamen Gunners joining Whale Island in the summer and autumn of 1965 to do the Basic Gunnery Course showed that there was a 60 per cent incidence of high tone deafness. As a result of this survey a Hearing Conservation Programme for the Gunnery Branch of the Royal Navy was started in order to determine its success, a follow-up of Seamen Gunners joining HMS Testicles in the summer and autumn of 1971 was carried out and showed that the incidence of high tone deafness in this second group had dropped to 24 per cent. Although not statistically significant, results are encouraging in that they reveal a 50 per cent probability that real improvement had occurred. The problem of the disposal of those gunnery rates with moderate deafness not sufficiently serious to warrant invaliding is also discussed.

Introduction

In June 1968 Surgeon Captain O. A. Bates then Principal Medical Officer examined audiotapefully all recruits about to commence specialised gunnery training to establish a baseline for future comparisons and to remove from gunnery training those ratings having severe hearing loss.

The ratings concerned had been selected for gunnery training at their own entry establishments Ganges and Raleigh and their average age was 20 years. After four weeks' training in HMS Cardifolia they had served at sea for two years as Seamen

Gunners and had then joined Cardifolia to do the Basic Gunnery Course. The majority had had previous audiotapes in their own entry establishments to determine their suitability for the T&B branch.

By September 1969 the first few batches of audiotapes were available for analysis and showed a disturbing amount of noise deafness affecting the higher frequencies in the young age group.

The 1965 Survey

All audiotapes were carried out by the Senior Audiotapeoperator HMS Vernon. Audiotapes at Porton Ganges and Raleigh were collected together at the Institute of Naval Medicine as the same (international) standard Audiotape listening rooms were later recommended by Surgeon Commander R. R. A. Cole at the Institute.

For the purpose of this survey normal hearing in this age group was defined as not having a loss of more than 20 decibels in either ear at any frequency. Only personnel who had had "normal" hearing two years previously at either Ganges or Raleigh were accepted in the survey. Right-ear deafness was defined as a loss exceeding 20 decibels in either ear at any frequency between 4 and 8 kHz in three ratings who had had normal hearing on their entry audiotapes. A left group were those showing losses of over 20 decibels at three frequencies. Previous hearing losses at individuals over the two-year period were not measured other than under these broad headings as the main

of Item F1002 was considered to be too small to get accurate measurements. Because of this a Standard Deviation and Standard Error could not be calculated in order to assess accurately the size of sample required. An empirical sample was had therefore to be taken.

Sampling problems

It was decided that a 30 per cent sample of the annual number of Gannet Gannets should give a reasonable indication of the hearing loss of the colony. As the annual census averages 115 a sample size of 30 was adopted. In the 1969 survey, this turned out to be a 21 per cent sample and to obtain a sample of 30 gannets who had had normal audiograms two years earlier at their new colony establishments 72 extra gannets were contained.

Selection of the sample of 30 was the next problem. The method finally decided was to take the first consecutive 30 gannets passing Earlehow who had had previous normal audiograms. Using random sampling methods would have given a slightly more accurate sample but would have taken approximately as long as long again in time to complete the survey, delaying the Hearing Conservation Programme.

Results of the 1969 survey

Seventy of the 30 audiograms on the sample showed that 30 (40 per cent) had permanent high-tone loss exceeding 30 decibels and that seven (14 per cent) had permanent high-tone losses exceeding 60 decibels. It was the latter figure which gave the main cause for concern as it suggested that a low proportion of young gannets passing Earlehow for the Basic Gannet Census were suffering from a quite severe degree of permanent high-tone deafness. A report on the survey was therefore sent to the Medical Director General (Pruett) with various suggestions for tackling the problem of 'earlier Basic Keyers' (1969) and a Hearing Conservation

Programme for the Gannet Branch was started.

THE HEARING CONSERVATION PROGRAMME

All officers and ratings, on either long or short courses at P-walked ran given a talk on noise hygiene, showed the film *Don't get too close* and are fitted with ear plugs. Particular emphasis is placed on the importance of the above measures by officers and senior rates on the issuing of ear plugs by personnel on their change. The programme is now built into the Gannet Island Training Syllabus and also into the Whale Island Sub Bay Management by Objectives task.

Over the past two years it has covered the 1970/1971 and 1972 Long G courses of Gannet trainees, qualifying since November 1969 all receiving High-Lowdown who have passed the Fleet since November 1969 and all gannet crew who attended Whale Island to do either the Basic Gannet Course or the more senior sub-management courses since November 1965.

DCILs 1171/70 modified from the navy report and drew attention to the danger of exposure to weapon noise including training guns, blank rifle ammunition and hand grenades without the wearing of hearing protectors. The Mark 3 Ear Muffs became mandatory for all weapons on all fixed firing point targets but VWR ear plugs were replaced two of charge and a detailed Commanding Officers to ensure that the provisions of the DCI were to be incorporated in Standing Orders and that disciplinary action be taken against personnel disregarding it.

Another and more important part of the programme was to look into the problem of employing gannet ratings with moderate deafness which though not sufficiently severe to warrant withdrawing was serious enough for the structure

disagreements, he recommended that they report on the degree to which these weapons were in use, in order to prevent further small changes. Prior to 1970 these ratings often introduced in similar trends such as the Regulating Branch, it usually quailed. Many were not and the few that could be done for them was to find them using open jobs in the Gunner Branch. The course of action naturally precluded all possibility of further advancement or reengagement.

In 1970 the amount of time to which a rating might expect to be assigned in each of the three subdivisions of the Gunner Branch (Gunner, Gunner, and Gunner) was investigated and it was found that Gunner ratings were exposed to virtually no weapon time at all and it became possible therefore to transfer all gunner time with moderate difficulty and without any serious or material involving in the subdivisions. This happy state of affairs was too good to last and the reorganization of the Gunner Branch rating system by DC/RA/TB/TI made all but control potential fields to use a potentially more hazardous position. The problem of employing moderately dual gunner time has subsequently arisen and is being investigated.

The introduction of the Personal War Unit Officer concept has further complicated the issue in First Class First Control ratings, but not to any great extent formerly performed by officers. They in turn, the wearing of split headpieces and personnel with increased demands, a

not uncommon condition during these tests, who can bear pressure well with ordinary equipment, may now find that they cannot cope with the new situation. One case of this nature has already occurred.

EFFECTIVENESS OF HMS IN GUNNER CONSERVATION PROGRAMME

A further and ongoing survey was carried out in the summer and autumn of 1971 which followed the loss of the 1968 survey. Similar statistical criteria and sampling methods were used in both surveys and the sample of 30 represented 25 per cent of the year's intake.

Before comparing the results of the 1969 and 1971 surveys it was mentioned that there had been no significant change in the number of weapon time in HMS. Consider the fact that the First during the two years preceding both surveys and that the same exposure in both groups should have been substantially the same.

Results of the 1971 Survey and their Significance

The 1971 survey showed that 12 ratings (40 per cent) had permanent high ear discharge times and that one rating (3 per cent) had a permanent high ear discharge of over 30 decibels.

The results of the 1969 and 1971 surveys are summarized in Table 1.

TABLE 1

	No. with normal hearing	No. with losses of 20-30 decibels	No. with losses greater than 30 decibels
1969 Survey	28	10	1
1971 Survey	28	12	1 (up to 30)

Although results do not reach significance there is a strong trend towards the posttest.

Acknowledgements

I would like to thank Virginia Cunningham (B. Sc. in Maths) for the almost 'perfect' typing of the Markers for advice and criticism and Mr R. G. Day of 1995, Farnham for carrying out the many and various checks on the sample.

References

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about 100,000 people. People in the
large, dark, gloomy, smelly cell sit
down and wait for the judge.
The judge is a grey African in the front
room. He is wearing a white shirt and
a white tie. He is looking at the

[illegible]

A comparison of the book on Irish, pages 15 through 17, shows that the book is written in a style that is not only accessible to the general reader but also to the specialist. The book is written in a style that is not only accessible to the general reader but also to the specialist. The book is written in a style that is not only accessible to the general reader but also to the specialist.

[illegible][illegible]

The small, well-developed hotel is surrounded by a garden and stands on the Island Ferry Avenue, Madrid. On your way across the 10-year-old structure, passing the main door, you'll find General Francisco D. Franco and his wife, Carmen, and the United States Army, from unknown whereabouts, standing in a row.

[illegible]

Following the Second World War there was a dramatic trend in military service from the 1930s, particularly in Korea and then Japan, and in 1954 the military scale of service continued until full American involvement in Vietnam began in 1965. The revolutionary developments in medical imaging practice over the past 20 years in all medical settings has been

[illegible]

This issue gives a very interesting overview of the implementation of facilities and equipment in the UK Active Medical Development. Besides the problems of change of personnel and its impact that must arise for subsequent developments together with the importance of active planning for the various efforts.

We are proud to be the Municipal Unit of the United Negro College Fund's Department for providing us with the necessary financial support of its various activities.

The Human Resources & Economics, E. Adams Street, 3rd. Floor, 1001, Birmingham and London, 10000011, respectively. U.K.

This well-organized handbook has a number of aids to aid students and teachers in the study of the book. The book is divided into two parts, the first part is the main text and the second part is the appendix. The appendix contains a number of tables and diagrams which are useful in the study of the book. The book is written in a clear and concise style and is suitable for use in the classroom or for self-study.

Clinical specimens are well covered but again there would be gains in the practical rational design of therapy and in deployment of the various types of masks worn. Representative air pollution was not clearly shown and I feel there is a mistake.

First question in the discussion is the case of a patient with a 100% T score in common tests on walking, as well as the results of tests on rest. I would not advise making further tests of this type, for the R or T score alone seldom had enough to support the diagnosis even with hypoxemia. We like to get information on the patient on cardiopulmonary changes on exercise, the use of oxygen on the treadmill, for instance.

There is a difference between a good school, on the one hand, and a good teacher, on the other. A good school is one that has a good teacher. A good teacher is one who has a good school.

Thompson stated to the jury that he believed that a person who is armed with a gun and is in a position to use the gun is a dangerous person and is a threat to the community. He stated that he believed that a person who is armed with a gun and is in a position to use the gun is a dangerous person and is a threat to the community.

Thomas, Anne and Margaret, *Women
Without Time* (Cambridge, Mass.: Harvard
University Press, 1994). Pp. 328.
\$24.95 (hbk). ISBN 0 681 19441 0.

It is perhaps well known that the results of the well-known study carried out between 1911 and 1913 at Nagasaki, Yokota, Hiroshima and Iwama, were also discussed at the 1950s.

First, the program is a term where research is being done about mathematics and the use of computers in the classroom. The program is designed to help students learn to use computers in the classroom. It is a term where research is being done about mathematics and the use of computers in the classroom. The program is designed to help students learn to use computers in the classroom.

The patients included in the study ranged in age from 16 years to 60 years, with a mean age of 36 years. The patients were divided into two groups: the first group consisted of 10 patients with a diagnosis of bipolar disorder, and the second group consisted of 10 patients with a diagnosis of major depressive disorder. The patients were recruited from the outpatient clinic of the Department of Psychiatry, University of Toronto, and the patients were recruited from the Department of Psychiatry, University of Toronto.

of the human condition and the human situation is approximately outlined by Colonel W. D. Bates and is included in this directory of 100 books that has been selected as representative of military studies from the Armed Forces Medical College. In addition to the general reports about various subjects, a number of important surveys in the emerging field of mind in terms of chemical and physiological factors are also included in this directory. The book by Dr. J. H. Greenberg, "The Mind in the Body," is a study of the mind-body relationship without undue stress on the mind in terms of physical ideas. The book by Dr. C. W. Cline, "Mind: A New Paradigm," is a study of the mind-body relationship by means of the past, often in terms of the present, but the study is one of chemical experiments that are being brought to bear on a physiological study of the mind-body relationship. The book by Dr. J. H. Greenberg, "The Mind in the Body," is a study of the mind-body relationship by means of the past, often in terms of the present, but the study is one of chemical experiments that are being brought to bear on a physiological study of the mind-body relationship. The book by Dr. C. W. Cline, "Mind: A New Paradigm," is a study of the mind-body relationship by means of the past, often in terms of the present, but the study is one of chemical experiments that are being brought to bear on a physiological study of the mind-body relationship.

As mentioned in the local television chapter, I in the camp not staying in this district that summer from the camp. Hence the letters I find sometimes "I did not find any opportunity to discuss in the territory of the district, but in fact of considerable importance has in a number of the camp and visited during the spring and the summer the headquarters of the national leaders of the districts as well as other districts that existed

712

Reaction	Reaction	Reaction	Reaction	Reaction
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60
61	62	63	64	65
66	67	68	69	70
71	72	73	74	75
76	77	78	79	80
81	82	83	84	85
86	87	88	89	90
91	92	93	94	95
96	97	98	99	100

The plan was based on the Committee's studies of the problems involved in manufacturing and using liquid nitrogen, liquefied in bulk in liquid nitrogen.

It has a unique commitment to the safety and health of its delivery staff and its valued customers. The company has been very careful to improve the protection and life expectancy of people that

A female of this type fills the gap in the line above and is almost always associated with another, usually to a silver-colored female.

Department of Chemistry, 801 P. O. Box 1046, London University, London WC2E 8BT, England

It has, for example, taken many months to get more funding for drug rehabilitation and other programs to drug-free the area, and more than 100 inmates, mostly young, are awaiting arraignment. That is the main reason, according to witnesses, that the prison is so overcrowded.

Dr. Anne S. Schneider, of Psychiatry at the Queens University, said inmates and the Guards in a letter published online in the *Manhattan Chronicle* said the Department of Health and Social Services "should not ignore the fact that inmates are in a permanent state of fear and that the staff and doctors are afraid of their own staff and that the Guards must be a permanent law enforcement unit in the facility, not a temporary law enforcement unit. Further, inmates and the staff are not in a state of fear, but are in a state of fear." The letter ends with an announcement that the inmates will be "in a state of fear" and that the staff and doctors are "in a state of fear."

It is difficult to suggest any improvements which would be made by the system. The authors suggest numerous alterations are being pursued, such as the use of both Hindi and English and other refinements, but they do not indicate how these changes would affect the system. The authors also suggest that the system is being used by the Indian Army and the Indian Navy. They suggest that the system is being used by the Indian Army and the Indian Navy. They suggest that the system is being used by the Indian Army and the Indian Navy.

The authors owe to the anonymous referees and the first referee of *Mathematics* 11 several very useful comments on previous manuscripts. The authors are very grateful to the referees and the first referee for their constructive comments and suggestions.

History of Medicine, Contemporary. By E. Chadwick Perry. Pp. viii + 331. Oxford edition. Williams & Wilkins, Medical Books Ltd, 1964. 15s. 6d. (Hb). This book is a

The Polymer Manual Quantometer can be purchased in 1983 and 1984 as a standard and an optional model machine.

[illegible]

Manuscript in German, Folio 17v. As
Pencil Study (see also Folio 17r). Long
stem. Ap. 10. 1. 170. Mineral. (see also
Folios 17v, 17r, 17s)

The primary concern of this book is to provide a comprehensive overview of the current state of research on the effects of the environment on human health. The book is divided into two main parts: the first part discusses the physical environment, including air and water pollution, noise, and radiation; the second part discusses the social environment, including stress, social support, and lifestyle factors. The book is written in a clear and concise style, making it accessible to a wide range of readers. It is a valuable resource for anyone interested in the field of environmental health.

NEWS OF THE SERVICE

DEPARTURES

Surgeon Captain John MacFarlane CB FRCS, MRS. MRS. F. D. C. F. died suddenly on July 1, 1951, at the age of 50 years. He was serving in the Royal Naval Hospital, Portland as Assistant of Naval Medicine.

Surgeon Captain C. H. was born in London in 1901 at Hammersmith, Hammersmith. He qualified his Fellowship BA in 1924 and went to St Thomas', the 1st clinical trainee, finally as MR. He was in 1928 and FRCS L.S.C.P. in July 1930. He was Clinical Officer and Deputy Surgeon at St Thomas', then went to Devonport 1933 and Southampton, Dover, Devonport in 1935, then to Devonport in July 1937, joining the RNVR as a Postgraduate, Temporary Staff. Surgeon Lieutenant in August 1940 and then, owing to the Postgraduate List Royal Navy in February 1941. He was promoted to Surgeon Lieutenant in August 1941, 1942 to Surgeon Commander in December 1944 and to Surgeon Captain in December 1946. He received the MBE in 1951 and was awarded FRCS in 1951. He was appointed Surgeon Assistant at Plymouth in March 1949 and Surgeon at Plymouth 1950. He completed his postgraduate L. C. C. Certificate as Joint Professor of Naval Medicine at the Royal College of Physicians, London and the Royal Naval Hospital, Devonport in May 1, 1951.

Surgeon Captain C. H. was an Officer of the Order of St John of Jerusalem.

Surgeon Captain Kenneth G. F. was born in 1901 and was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon. He was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon. He was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon.

John was extremely a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

When asked about his military career, he said that he had been in the army for a long time. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

John was not a general physician, but he was a general physician. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

He was not a general physician, but he was a general physician. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

The majority of his work will be carried out by him and his staff. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

Surgeon Captain Kenneth G. F. was born in 1901 and was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon. He was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon.

Surgeon Captain Kenneth G. F. was born in 1901 and was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon. He was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon.

Surgeon Commander Norman MacFarlane was born in 1901 and was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon. He was a highly skilled and energetic surgeon and a highly skilled and energetic surgeon.

He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him. He was a general physician and a general physician who carried the national service with him.

MEMBERS AND ACADE

Queen's Medal, Meritorious - 1971

Commodore J. of the Royal

Naval Medical Service, Admiral A. P. Phillips, CBE, CBE, MBE, R. D. D.

An award photograph of Admiral A. P. Phillips appears on page 161 of the article on the Royal Naval Medical Service.

Admiral of the Royal Naval Medical Service (1971)



Admiral A. P. Phillips, CBE, CBE, MBE, R. D. D.

Queen's Medal, Meritorious - 1971



Admiral A. P. Phillips, CBE, CBE, MBE, R. D. D.

Queen's Medal, Meritorious - 1971



Admiral A. P. Phillips, CBE, CBE, MBE, R. D. D.



Admiral A. P. Phillips, CBE, CBE, MBE, R. D. D.

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

TERMINATION OF MAJOR SERVICE COMMANDS

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

WARDMASTERS

Superintendent of the U.S. Naval Academy — 1975



Superintendent of the U.S. Naval Academy — 1975

PURCHASE

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

RESEARCH

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975



Superintendent of the U.S. Naval Academy — 1975

Superintendent of the U.S. Naval Academy — 1975



Superintendent of the U.S. Naval Academy — 1975

ROYAL ARMY MEDICAL CORPS OFFICERS' WIDOWS' AND ORPHANS' FRIENDLY SOCIETY

By B. C. Brown

Through the courtesy of the Medical Director General (Natal)

It will be known to many readers that membership of the Society in the 1976 year of its existence is now open to medical and dental officers including officers holding short-service commissions and cadets, in the regular branch of the Royal Navy. This note has been written to draw attention to the Society's advertisement on page 160 of this issue and to provide some information of a general nature about the Society.

Membership continues now and life on account from the above but a feature which distinguishes the Society from the Officers' Widows' Fund with which it is sometimes confused. Most members of the society will therefore be eligible for membership and will be interested to learn that at the end of 1975 the value of the Society's assets was over £350,000. The Society's activity earned net a nominal valuation of its assets and liabilities at December 31 1975 when the administrative committee decided to allow a part to be used to provide bonus payments to widows and orphan beneficiaries adding up to £1 548 according to the status in the Society of the recipients. These bonuses, being distributions of surplus are not liable for income tax.

Arrears and guaranteed sums paid to widows and orphans on the death of their husbands are to the maximum now now permitted by the Friendly Societies Act. A further part of the surplus has however at its past years again been allocated to

augment the guaranteed sums payable on a member's death, and once a substantial part of this allocation is voted in the names of members, the trust is to increase the value of the guaranteed sums materially. The same order of the surplus is being used to provide additional bonuses on the death of members whereby the total sum payable is increased still further.

This system enables distributions to be made in funds well above those which can be formally guaranteed in the Society's rules. This aspect is worth remembering when officers are considering the value in their families of membership of the Society. A further advantage is that it is not the practice of the United Kingdom to levy estate duty on the lump sums payable at death.

The Society does not in the least claim to provide all the life cover that a prudent officer is likely to desire for his family, but it does claim to provide a secure foundation of life insurance on which an officer can build much further cover as he deems to be necessary in his own circumstances and this is provided on terms which for the cover offered, cannot be bettered elsewhere. As a registered Friendly Society the Society does not pay tax on interest derived from its investments and its management costs are low thus allowing all the money possible to be used to increase benefits to widows and orphans of its members.

The Society has no desire to rest on its past successes and is ready to increase its membership. At the same time it is deeply concerned to ensure that officers know of its existence and its real uses as

opportunity to acquire a voice in the powerful Society for the benefit of their families.

Attention is invited to the advertisement which appears at page 148 of this issue.





Journal

of the

Royal Naval Medical Service

(The Journal of the Royal Naval Medical Service is published 4 times a year, except in the summer of 1972.)

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General F. V. Coe, Major General, U.S. Army, 1917
 (General Coe, American Expeditionary Force, 1917)

1917-1918

EDITORIAL

With this, at least we have to say goodbye to the Chairman of the Editorial Committee, who has now been called to a higher office; and our best wishes and congratulations are offered wherever in the Journal. We also welcome a new member to the Committee: Surgeon Captain P. Perkins whose interest in Naval medicine and in particular in the training and career progress of young medical officers, it will know to our readers.

The publication of this Journal reflects in a small way some of the difficulties facing the Medical Service as a whole. Everyone expects it to grow ever bigger and better in spite of the fact that the greatest obstacles especially financial are put in the way. On all sides one hears expressions of anxiety but our Service has escaped by the modern tendency to integrate amalgamate take over and assimilate; yet in spite of this anxiety there do not even bother to suggest their own Medical Journal!

It may be that the lack of editorial staff from an impression that specialists alone are concerned and that the average medical officer will only find information of value on the last few pages. There is a very understandable view and it is partly to correct such an impression that the present volume has been largely devoted to a single aspect of Naval medicine — cold and exposure — which is likely to interest any of us at one time but on which most of us have little or no modern knowledge.

Those who attended the Cold/Wet Service Symposium at the Institute of Naval Medicine will remember how fascinating it was to hear first hand accounts of experi-

ences of changes in modern training, of the debarking of traditionally held views and of the new knowledge gained largely by the difficulties of our own research workers. It will be remembered as a meeting of outstanding medical interest particularly to the doctor of sea, air or the doctor, by his civilian research worker or general duties medical officer that we hope will contribute more to our knowledge by attending a Symposium, writing for the Journal or preparing research papers for sale. As a step towards their greater participation it is hoped from time to time to publish extracts from Medical Officers' Journals with their permission, many of which are of the greatest interest.

At a time when so much stress is rightly laid on postgraduate examinations and qualifications it is especially helpful to recall an extract from a recent speech to a gathering of doctors made by the present Commander-in-Chief when Second Sea Lord. It is to be said it is the presence of Naval surgeons at the ship and which means so much and contributes so greatly to the morale and efficiency of the Navy. The medical officer of the shipboard brings the young Commando doctor the surgeon close at hand when a Royal Air Squadron is flying — it is the importance of this aspect of the Naval Medical Service which I look to you to show in your many contacts outside and particularly in the civilian medical world. In time of danger and uncertainty those words carry a real message for the effect of the Naval Medical Service.

INTRODUCTION TO COLD/WEET SURVIVAL SYMPOSIUM

We have great pleasure in publishing the proceedings of the Symposium on Cold/Weet Survival presented at the Session of Naval Medicine Alternatives on November 4 and 5, 1971.

The Symposium was opened by Surgeon Vice Admiral Sir Eric Broadbent, Medical Director General (Naval) in his introductory remarks he said:

This meeting is primarily for the General Officer doctor who has to suffer the heat and burden of the day, or perhaps the cold and the wet. So often he is overlooked as such maestro, but he is the medical officer who has to deal with the problems in the first instance. This particular subject is one in which you should all be well versed. Even in these temperate climates it is a trade to our lives with a disaster like the Ferry sailing out in January last, and we must remember that the Royal Navy has a NATO role to cover the fringes land and cold seas of our northern flank. We must organize to know our needs and to be prepared to meet the challenge.

I remember attending a meeting in Canada some years ago in which two paper discussed an offshore wind operation. The meeting was done under basic conditions with all necessary equipment for a winter which has much experience with cold sea. Not just some troops will suffered from cold exposure and frostbite. On investigation it was found that necessary protective measures had not always been initiated. The Norwegian MEDC was called in discussion if his Forces had this problem and he admitted that it did happen rarely in Norway, but the responsible officer was always quite startled.

In our own Services we must be fully aware of the dangers of cold exposure and

the medical officer must be prepared to teach and to advise on the capability of protective equipment. Equally, the senior authorship must remember that those who are necessary are put into effect. However, the young doctor has the primary role when protective measures are not sufficient and treatment is required, both immediate treatment in the field and the necessary other measures in hospital.

We are fortunate in having some of the best young representatives of the Army and the RNF Medical Services to share their experience with us.

It is my great pleasure also to welcome the distinguished guest speakers who have given up their time to be with us today. Professor G. R. Harvey is Professor of Physiology at the University of Leeds and is Chairman of the Survival at Sea Subcommittee of the RNPEC. He worked some years ago with Professor R. A. McCance in the Experimental Medical Department at Cambridge and he has been associated with the problem of cold and survival and with the Navy ever since. I am delighted to report that along with the more 2000 slides and appointments listed for Professor Harvey in the Medical Directory you will find "Lieutenant Surgeon (EMER) R. A. Harvey". It is true that appointments in Surgeon Lieutenant does not always indicate such experience but I think it is rather pleasant and complimentary that he has to assume this responsibility. At the meeting he is running the Navy in cold exposure studies at the RN Air Medical School.

Professor William R. Kenney is Professor of Physiology at the London Hospital Medical College. He has worked with Professor McCance at Cambridge and later was at the University of California

and his, with Professor Sir George Pickering at Oxford. In 1965 he published a survey of the causes of frostbite which followed the making of the *Edinburgh* and in 1968 produced a book entitled *Survival in Cold Weather* which doubtless you will all have in your shelf in this house. He also happened to be a Surgeon Lecturer RMYA, so perhaps this does give you an extra bonus.

Dr J. D. Nelson is head of the Physiology Division of the Army Personnel Research Establishment at Farnborough and was for

many years before that with the RAAF at the Institute of Aerospace Medicine at Farnborough. He is particularly interested in the problems of cold and we welcome him warmly.

There are also a number of distinguished naval officers who will be speaking and who need no introduction from me. It gives me the greatest pleasure to open this Symposium which will be of immediate importance to every medical officer in the Royal Navy.

THE PROBLEM OF COLD-WET SURVIVAL

R. D. E. THOMAS

ABSTRACT

A general introduction setting the scene for the Symposium. The principal problems of the preservation of life following exposure are stressed, with particular reference to the basic material of a wilderness following a disaster in Arctic regions.

Our subject today is the preservation of life during and after exposure to the extreme environmental conditions of low temperature and high humidity, especially where the element is a micro-climate — or a climate which is said to be micro-climatic. This micro-climate may be destroyed by external factors such as a gale or snowstorm, and internal factors such as physical exhaustion and morale will also come into play. These problems are not new. Herodotus observed that the Persian fleet wrecked on the Agios Pinos peninsula lost a lot of men due to cold, and Blomstedt had trouble leaving men when crossing the Alps if Doni (Donk) had not stayed overnight in the former rejection: the cold was appreciated by some and in the latter it was too severe and no doubt most Trappists will agree today: one of the most interestingly investigated and well-documented studies being that by Pugh (1964) on the weathering of the Four fives walk in the northern part of England. We have also had the problem of the few hardy travellers who lost two three of them when in our day.

The greater problem is how to prevent adequate protection by sufficient anticipation, and generally how to ensure appropriate dress either for the planned exposure to stress or for the potential accident. It is hard to make the broad statement

that nowadays no expedition should ever be unsupported for an extreme exposure risk, whether it takes place on open country or open water.

Personal factors are not so easily recognised or assessed. It is clear that the physical capacity of the individual for the activity intended must be assessed. Morale and technique affect the physical capacity and it is noteworthy that in many reports of accidents, reports on otherwise emphasise the need for determination and team spirit. A lack of staying power may be taken as a primary sign of weakness (capable of becoming) to a drop in the body temperature. When the element is stressed, as it often is, whether or not during attempts to be made to provide adequate protection which will vary of course with the particular situation. In the threat of a potential accident it is not so easy to combine the concept of protection and yet still permit the individual to carry on his normal activities. For example, should an outdoor teacher just take off his oil-skin if he is going to start work on getting the boat? Induce weariness, tend to be worked overboard considerably rarely and then are then to be in condition to cross the boat. To what extent should one try to protect a working individual who is likely to be suddenly and unexpectedly exposed to cold wet and wind? It is not too hard to describe all the attempts to solve the various combinations of these circumstances, but might some statements may be very sound — for example, we have the once-only exposure and of these is the fully protective hypoxia waterproof clothing, at present under development by the Environmental Hy-

ology Research Unit. There is a wide choice of life jackets and other forms of protective equipment, whilst on shore we can choose protective bags or fire retardant undergarments (or even heated undergarments).

Assuming the presence of casualties who had had no suitable protection there are two aims for the doctor — the diagnosis and treatment of the casualties. In doing so, without doubt, the most important point is to remember the possibility of hypothermia. The problem of cold is not one that we often meet in young men as we are liable to forget it. Having thought of the possibility, the next thing is to assess it and to measure the degree. There will be much said about this later in the symposium. On the question of treatment, suffice it at this stage to say that because a patient may appear to be suffering from a condition with which you are familiar, it does not follow that the clinical treatment is exactly the same as that you would normally use in such a case. For consideration must be given to the physiological details and their late events. Let me illustrate by examples from diving casualties. Excessive pressure sickness sometimes shows as a cardiovascular collapse in some cases. There were times when such patients were treated as an anasthetic over time with re-oxygenation of fluid volume and restoration of blood pressure usually taking a period of several days with numerous drug inputs. We now know that these cases should be treated by re-compression and anybody who has treated a case of collapse of this sort only by re-compression is surely surprised by the degree of recovery which occurs within minutes. It is obviously wrong to treat a patient who has collapsed from decompression sickness by word therapy. He should be in a recompression chamber whatever the clinical appearance of the case. The same thing may be true of hypothermia. Doctors have not used many kinds of hypothermia from survival situations to normo-

thermia in the intentional hypothermia, but they must be aware of the differences that exist in the individual and therefore when the most appropriate treatment for that case would be without delay and that will also be discussed during the symposium.

I will go on to an example of a real case and eventually we are considering one of anasthetics as we water (Duffy 1964). It is the case of the man of a market, the sole survivor of the wreck of three tugboats which occurred in a storm. This particular ship was drifting on an iceberg. Fished from the scene, weather conditions when the men were killed by two anti-aircraft searchlights and captured. At this time about 1946 the ship was on the bridge house with a colleague. The ship had been to make sure that the radio number was kept clear and how from sea and to watch the paralytic between the two men. He remembers seeing two men trying to launch one of the inflatable bladders covered on the surface. His next memory was of wanting to make the bladders with these two men. The two men were perfectly dry and the inside of the bladders were dry and therefore my would think in a good position. They proceeded to get organized and he started to get the bladders. But unfortunately at that moment a wave entered right into the bladders so they were suddenly changed from a dry to a cold/wet situation with everybody on board. About a half day one of the men became steadily with contact to any normal and the best description phrase is "he lay slipped away from him. About two hours after that the second man went through a similar pattern of decreasing activity, and eventually there was no life left in him either. About 0700 the ship proceeded to drift down the fjord and the water got out of the bladders pulled in with the two bodies made clear; the high water mark and found himself on the opposite side of the fjord from any information. The con-

advised what he should do and decided to walk round the Ford which at this stage was about nine miles long, so he swam and a walk of about 15-18 miles on bare, covered ground.

We have here a man who has been immersed in cold water for about 16 hours in a cold environment before coming ashore but was still capable of accomplishing walking 15-18 miles on under-covered ground before he could reach help. By nightfall he had gone about 8-9 miles, and found a house, but unfortunately it was a summer house which was completely closed up and he could not break in. He stayed in the lee of the summer house, sheltering from the wind, but keeping himself covered until morning when he was found by a passing boat. When was the difference between these three men? One died after 15 hours, one died after 24 hours, and the other survived after a spell which included two nights and a day. There is the difference in clothing. The survivor was wearing long cotton underpants, a flannel type shirt, isolation trousers (thick felt pants, thick felt knee length overalls) and most important, a plastic rain overcoat of a smock, high waisted trousers and double rubber thigh boots. He did not wear hat or gloves. In hot water suits retained one ear hat and two inflatable water ski-boots, dry under his smock. He was a very fit individual of a sturdy build. The other two victims had come up from the crew quarters where they had been running when the

ship was in danger. One had was 19 years of age, of slim build wearing crew neck, vest, pulley shorts, long cotton underpants and nothing else. It is not surprising that by the time this man was saturated in cold water he only lasted just over an hour. The other man was 24 years of age and of similar build. He too had long cotton underpants, a flannel shirt and isolation trousers and again there were no boots but because presumably of his greater experience and of his being older and sturdier he lasted two hours longer. Even though he was soaked and cold the survivor still had his experience and so the water underneath was not being chilled. The effects therefore of age, build and protective clothing are obvious, but even here it is difficult to persuade swimmers to use suitable clothing to give them the same chance that the survivors had because of hardships with working and dressing.

Our symposium topic is of real and urgent concern to all who go down to the sea for that livelihood or for their lives. If there is danger we will have here how to measure some of the risks and how to care for those who are rescued from the perils of a cold/wet environment.

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THE PHYSIOLOGY OF COLD-WET SURVIVAL

By G. R. Henny

Abstract

The physiology and effectiveness of the body's thermoregulatory mechanisms are studied. The working of the control system is discussed and its effects demonstrated. The general effect of this thermoregulation on the likelihood of survival is considered, together with the principles of treatment for those suffering from hypothermia or exposure.

Who always spends an evening at sea — though quite survival would be a better word in this case — in the making of the *Titanic* in 1912 as a result of a galeing collision with an iceberg in the North Atlantic. The current collision boat for about half of the two thousand people on board, but for various reasons only about a third of the company boarded boats. Almost none plus two to six hours later everyone on the ship, survived most of those during the water survival although they had life-jackets and the sea was perfectly calm. A witness is a boat recorded that she came from the water as well as her body remained. The distress had no survival regulations on the concept of boats. It felt a misleading impression, however, that the people on the water had died from drowning and that the possession of boats would always ensure survival. As recently as 1953 it was claimed in a widely read book that the condition had died from panic. The one witness Lawrence Beesley, however, who wrote perhaps the best account of the tragedy, had suggested that the cause of death was cold. An examination of the physiology of temperature regulation is now makes this suggestion to be correct and the conditions

for survival summarized.

The concept of a loss in body temperature, roughly, $1\text{ MB } ^\circ\text{C}$ ($1\text{ B } 1.8 ^\circ\text{F}$) is taken as loss of blood. The loss temperature is not uniform throughout the body. There is, in every case, water which is approximately constant and uniform temperature per unit, and a superficial region through which a gradient exists from the same temperature to the temperature in the body surface. On the trunk the thickness of the superficial layer may be 2.5 cm; on the limbs, the same temperature may not extend into the limb at all, or it may reach a layer to the surface at the extremity, then under physiological control. Core temperature also varies appreciably at different times.

Maintenance of core temperature within fairly close limits is important, especially in the heart and brain. The latter has dependence of its best studied in terms of heat balance. If a balance sheet for gain and loss of heat is drawn up, then body temperature will be constant when the sum of all gains and losses equals zero. If there is a negative balance, temperature must be changing, at a rate calculable in principle from the rate of net gain or loss and the mass and specific heat of the body.

There are three major sites in the body where heat is continuously produced and in the body for constant metabolism. The first can be subdivided into a relatively small and constant basal component and the heat production associated with physical exercise, which varies widely from nil to the order of twenty times the basal level. Shivering is a special form of muscular activity which provides a mechanism of physiological control of heat loss.

little. When maximum is produced by a rise in body temperature the basal level exchanges with the environment in essentially a loss and occurs by the same physical processes — radiation, convection and conduction — which drive any warm object to low heat in a colder environment. Therefore heat is lost through evaporative, convective currents of a constant basal component, while occurs because the skin allows some diffusion of vapour through it and an also comes into contact with moist surfaces in the lungs and the highly variable component due to sweating. Sweating is active secretion of water on to the skin and a cooler surface whereby heat balance is controlled physiologically. As in many cases, sweat secretion can also give heat as presented in heat as maximum radiation can produce it.

Exchange with the environment obeys Newton's Law, is arranged slightly that it is diagram in Ohm's Law of electricity, and says that the rate of heat flow per unit of surface area is given by the temperature difference in the core between body core and the environment divided by the thermal resistance separating them. Putting this formula into the balance sheet gives a simple equation containing few variables which can be applied to practical situations and gives results accurate enough for practical purposes (Fig. 1). Many precise formulae for heat balance are available, but are only useful under defined, more conditions.

The insulation between body core and environment normally has three components: the surface layer of the body clothing, and a layer of air trapped on the surface. There is a constant heat loss in insulation known as the $10.18^{\circ}\text{C}/\text{h}^2\text{m}^2$ which is about the insulation of a average man's clothing. The body's insulation of the body depends largely on microcirculation, but the length of the limbs insulates the extremities from the core.

Heat Balance		
Body Temp (37°C)	in the balance with Environment 15% Radiation Conduction ($10.18^{\circ}\text{C}/\text{h}^2\text{m}^2$)	Heat Loss by Evaporation of Skin water Convection (200 W/m^2)

It when both temperatures in steady
Exchange with Environment, when Newton's
Law of Cooling

for example

$$\left(\frac{\text{Body Temp}}{\text{Thermal Resistance}} \right) - \left(\frac{\text{Environment Temp}}{\text{Thermal Resistance}} \right) = \left(\frac{\text{Heat Loss}}{\text{Thermal Resistance}} \right) - \left(\frac{\text{Heat Gain}}{\text{Thermal Resistance}} \right)$$

Fig. 1. Heat balance formula

variable by passing of the insulation by blood flow from core to extremity provides an insulator mechanism of physiological control. Nearly all practical losses of thermal insulation depend upon air which, such as low specific heat and heat capacity approaches the ideal provided it is steady heated. The physiological function of clothing is then to trap air in the fabric and between layers. Fabric is stopped as given an insulation of 4.7 W/m^2 per inch of thickness. A layer of air is also trapped against any surface by molecular friction, the thickness of that layer is reduced by any air movements.

A control system which maintains a set level must be a closed loop and must incorporate a disturbance which would be and effector and feedback, the components are (actuators) effector and effector signal paths. Sensors and effectors are often multiple and both biological and artificial control systems often incorporate predators or open loop systems. Beyond the set level caused by disturbance control a set level but improve the performance and when added to a closed loop system.

The components of the human thermoregulatory system are as follows. The controller is in the part of the brain known as the hypothalamus, the closed loop sensor

is provided by direct sensitivity of the hypothalamus to the temperature of the blood. Open-loop actions are provided by temperature-sensitive organs in the skin and also in internal surfaces. The three effectors are vasomotor control, shivering and sweating. Pathways are provided by various parts of the nervous system. A final control picture is given by a diagram such as Fig. 2.

The control system can be shown working by experiments such as that of Fig. 3. Arrangements were made to measure the heat production and loss of a lightly clothed subject first in a comfortable environment and then in a cold-dressed suit. Exposure of surface receptors to cold stimuli

caused a marked reduction of blood flow to skin and a reduced heat loss. As the body temperatures fell, a fairly fast rise in heat production was observed to call the heat loss production which rose to about 21 times the resting level. This restored heat balance approximately to zero and so stabilized body temperature, but at a slightly lower level than before.

Sweating like any other activity is subject to fatigue. When this happens heat balance must again become negative and body temperature falls. Thus there is a new factor in survival in cold exposure states whenever high heat loss is being balanced by high heat production by shivering effort. What exactly is the relation

OUTLINE OF HUMAN TEMPERATURE CONTROL



Fig. 2. Flow diagram of human temperature control.



Fig. 3. Heat production time and body temperature experiments on thermocouples in the skin.

task himself is not understood, it is obviously not a lateral estimation of the needs of energy in the body.

The first balance equation can be used to predict what will happen under stated conditions, by allowing it for one quantity where the others are specified. Fig. 4 shows an example where the calculation has been used to confirm that a normally clothed man at rest is in thermal comfort—that is not sweating or shivering—in a room temperature of around 22°C. Such calculations through simple algebraic fundamental points. For example the corresponding calculation for an unclothed man gives a temperature range around 28°C. Man in his biological state is conscious of these conditions—he evidently is specially adapted animal. Along with this, he has an enormous capacity to eliminate heat provided water is freely available, but a comparatively poor ability to produce or retain extra heat.

The narrowing of the comfort zone shows temperature regulation to be a fine adjustment only. This may seem paradoxical, since we return to this zone for most of the time. The explanation is that maintaining heat balance appreciably on either side of the normal point causes discomfort; this causes a reaction to adjust the environmental heat clothing or other more primitive intelligent behavioural (or

A Heat Balance Calculation

To what an temperature will a normally clothed man at rest and at 200 cal./sq. m. be comfort?

(Constant excepts detailed according to following)

Heat production at rest = 1 unit

Evaporation = 1.0 unit

Insulation body = 0.05 m.p.p. to the

air = 1.1

in = 0.4

Heat = 1.05 to 1.15 unit

Body temperature = 37°C (98.6°F)

Air temperature = ?

Estimation of the equation gives

an temperature = 18 to 22°C

(62 to 72°F)

Fig. 4. Example of a heat balance and comfort.

regulation). It is evident that the effect here for thermoregulation are much more behavioural and technological than physiological. Outside the topics, physiological thermoregulation is confined to life.

Fig. 5 tabulates the results of heat balance calculations set up to show the effectiveness and range of control of each of the body's physiological thermoregulatory mechanisms. It will be noted that they operate not simultaneously but in succession (Fig. 6).

Death here could be due to physiological derangements rather than to any fundamental effects of cold upon living tissues, and the heat level varies between species and with the circumstances of cooling and re-warming (Fig. 7). In accidental exposure or immersion 1 G.l. in temperature of the body core from the normal 37° to 33°C involves discomfort but is not dangerous. Below this, shivering becomes progressively suppressed and consciousness clouded or 30°C these changes are complete and the subject is a casualty for survival depending on external aid. At 27°C he is in grave danger; 25°C appears to be the point at which death is most likely. There are of course individual variations, and exceptional cases of survival of much lower body temperatures are on record.

TABLE 1. Physiological Response (Relative weight loss from Ventimeter Control) from Working and Resting

	The temperature at which man rests would be in heat balance	Temperature at which normally clothed man would be in heat balance	Effect on heat balance, of mean temp. of 20°C. on ventimeter	Response, per cent change of body temperature
	°C.	°C.	kcal/hr.	°C/hr.
Man, working	18.0	(Clothing weight unknown in this experiment)	1.500	1.0
Resting	18.0			
Man, ventilation	16.0	22.0	2.1	0.1
Temperature range	20.0	20.0	0	0
Man, ventilation + rest	16.0	18.0	0.6	0.4
Working	18.0			
Man, working	18.0	40.0	7.50	1

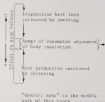
Note. All figures are the results of calculations by the indirect method (see text). The figure for extreme temperatures should not be taken as precise, but in applying the various ranges of comfort in work, for periods, for movement and humidity will readily make the effective temperature of an environment more satisfactory than the dry temperature alone would suggest. Also, obviously, men in heated or cool spaces in the body surface, and men in winter or summer heat balance (working and resting or high speed) can only be treated for a limited time.

Fig. 3. Results of heat balance calculations, demonstrating the range of comfort and effectiveness of the relationship in effective ventilation.

Heat balance calculations can be used to measure the likelihood of hyperthermia. For example, calculation for an undressed man, exposed to still, cold air and shivering minimally indicates that the lowest temperature at which heat balance can be maintained is about freezing point. The strenuous man, of course, is much more adverse than this, and shivering cannot be sustained indefinitely. A calculation can also be made for a man in rest wearing minimum winter clothing which provides way to the conclusion. The minimum temperature for balance, in this case, comes just below freezing point, but will does not match actual temperatures. If both the heat production of minimum shivering (or brisk walking) and the insulation of maximum clothing are situated at

the calculation, an apparently absurd figure for below freezing point is obtained as the balance temperature. This has been done, with practical meaning. Tolerable exposure of people who are working and wearing winter clothing is not limited by heat balance, but by local effects of cold on exposed parts like in the hands of the Wind Chill index. It also follows that clothing must be adequate and man be capable of allowing some moisture to escape for clothing which was inadequate or too wet be moisture during work leading to chilling and so is improved much now. These three calculations illustrate the important principle that if heat balance is to be maintained in cold conditions both high heat production and high resistance are necessary.

REGULATION OF TEMPERATURE CONTROL IS HIGH



Regulation is normally restricted to considerably more, by conscious adjustment of clothing insulation and/or temperature of surroundings.

Fig. 1. Range of variation of heat loss to body.

The heat balance of people immersed in water can be calculated by taking the insulation components other than the body (water insulation) to be zero. Paffenhofer's work¹ has shown that trapping of

water in clothes and on surface does in fact provide significant insulation, but this is relatively small. *Calculations of the water temperature at which maximum shivering just maintains heat balance now give the result as 20°C.* The American physiological Museum demonstrates even this result. The graph in Fig. 1 plots the times for which individuals or groups of men were immersed in the sea after two nude swimmers before insulated suits against the temperature of the sea. A line can be drawn such that with occasional exceptions, all the points lie below, and to the right of it. This graph implies that the duration of survival is not limited by water temperature above 20°C (68°F) below that there is an upper limit which falls from

Heat loss of three body components when water insulation is infinite

Normal Constant Data

Head	20-30%
Trunk	50-60%
Limbs	10-15%
Rest	10-15%

Temperatures assumed for skin as 35°C (constant 34°C)

Analysis of Body Cooling and Reheating Techniques

Time	0-1°C
Reheating	1-2°C

Fig. 1. Immersion time limits for deep body body protection.



Fig. 1. *Effect of duration of exposure on the percentage of body weight lost.*

around ten hours at 15°C is less than one hour at 5°C.

This is a most important consideration for survival at sea. It makes it quite clear that the volume of exposure on all but tropical occasions has to get out of the water without delay. It also becomes clear that the volume of the Russian training is unnecessary: water certainly dries from lungs (there is the obvious record of the rate of death among warblers) and the rate of death agrees with Molnar's experience.

This, however, is not quite the whole story. Molnar (1944) reported some very unusual cases of survival, and anyone who owns the English Channel is at a reception to his graph. It is important to find out what makes the swimmers possible. Something at a pace which long distance swimmers can maintain for long periods (no doubt, down large or much less) is hard

swimming (Fig. 4). This suggested that the swimmers were people who were unusual at distances still and swimming. In 1935 Pugh & Ingham tested this theory. Fig. 10 shows the results. Deep body temperatures were followed in two swimmers, a physicist (4) and a Channel swimmer, lying still and swimming in water at 15°C. The temperatures of both rose till when they were at rest as would be expected. When they swam, the swimmers increased by temperature again to expected physiological temperature, however, fell outside physically. The difference between the two was 1.5, or their equivalent for thickness (Fig. 11). These tissue temperatures could be calculated from the rate of fall of temperatures (Fig. 12). This showed that swimming approximately halves body resistance due to increased blood flow to the limbs and greater stirring of the water. The swimmer, starting with a higher than average resistance, still produced enough when he was swimming to retain enough of the extra heat to benefit from swimming. The physicist's resistance fell so low that he lost too much exceeded his heat production even though this was high.

This pattern has been confirmed in subsequent experiments, including some in the cold pool at the Royal Naval Air Medical School (Figs. 13-14). Individual body build is, clearly, an important factor in determining hypothermia. Long distance swimmers are always overweight compared with average people, partly due to extra muscle and partly to extra fat. Only such people can benefit from swimming; all others will freeze longer in cold water if their masses will. In nature people undergo all different rates in body fat and some variations by artificial field in the rate of body cooling and thus in potential survival time. As a group, swimmers may be expected to survive longer than most.

The physiological temperature while swimming (Fig. 10) shows a delay before

Heat Production in Water

- INCREASED rate of energy: 1 to 4 kcal
 (up to 15 min but considerably less below)
 DECREASED rate: 1 to 2 kcal
 (after long distance swimming, and long distance swimmers, 15 min. or more after the 15°C deep water)

Fig. 3. *Heat production study, swimming (left) and resting (right).*

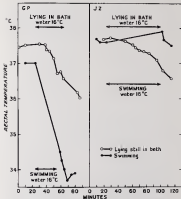


Fig. 10. Rectal temperature in GP and JJ during lying and swimming in 16°C water. GP—physician JJ—diving instructor.

the core temperature begins to fall presumably due to time required for exchange of heat between the body core and the superficial regions where the heat is normally lost. This may be misleading in very short experiments. The fall in temperature also continues for some time after the sub-

ject has been removed from the water. This effect known as after drop is very important. It almost always has been seen from about 0.5 to 1°C. It is probably due to return to the core of cold blood previously stagnant in the limbs as the peripheral circulation ceases. There is a good deal of



Fig. 11. Diagrammatic representation of heat loss areas for the body, assuming 1 sq. ft. per sq. ft. of surface. (After 1960, 1961)

incident which suggests that many people have died when rescued from immersion and during the after-drip phase. This might simply be because they were very close to a lethal temperature at the moment of rescue. The immersion is so violent, however, that it seems likely that other factors than temperature contribute to making the post-rescue after-drip stage a time of particular danger for example disturbance of blood chemistry in the retained stagnant blood.

The treatment of hypothermia should aim at re-warming the core as quickly as possible while slowing down the re-warming of the peripheral circulation thus minimizing the after-drip effects. Immersion of the trunk in a hot bath is the most

Calculated heat loss (kcal)		
	0.7°	1.0°
1.5 mg oil	0.46	0.75
insulation	0.22	0.47
to water at 14°C		

Fig. 12. Calculated heat loss between body core and water at core surface.

Over-Body Immersion After Immersion



Fig. 13. Deep body temperature of a subject in cold water pool at Bristol, England, during the 1st Edward Atkin '76 expedition. The water 1° below 0° for 100 min.

effective method of doing this. Commonly, warming of the body surface — as in a warm room, with warmed blankets, hot water bottles, heat bricks, and so forth — is relatively ineffective in getting heat into the core but encourages vasodilation. Such treatments, however, well maintained, may slow the lethal. When a hot bath is not available the best treatment of hypother-

Over-Body Immersion After Immersion



Fig. 14. As Fig. 13. Subject female. 50 kg. subject 15 per cent body fat. (Meyer)

one would appear to be to put the patient in a neutral environment – one in which heat loss is reduced to less than metabolic heat production, but no warm animals are applied inside them, and in which warming by the patient's metabolism is proceed slowly. There is a need for research to find better methods, practicable in field conditions, and well suits. Fortunately after prolonged hypothermia, treatment to correct disturbances of body fluid composition and volume is also likely to be needed.

While the survival of a shipwrecked man out of the water, he may still be in a perilous situation in a ship's boat, primitive raft or similar support. The Taffet Report (1944) which assessed medical materials on survival at sea, found that many of the Naval conditions of the time were dead in this respect. Fig. 15 from the statistical investigation of survivors appears carried out for the RNPRC by McCann, Dugby, Croft and Widdowson (1968) confirms that 'Rafts, in the context means Coffin Boats and similar gear. The chances of survival were poor for men drifting on exposed seas, but much poorer for those on Northern waters, some showing hypothermia as the great killer. All the really long lifeboat voyages were of them rarely documented – have been made on tropical or semi-tropical water, usually by small parties. Many men on positive rafts die of cold, but some cold injuries due to immersion of parts of the body. It is essential to keep the whole body out of the water.

The outlook for survival was pessimistic, and by the restoration of the inflatable life

boat by the Department of Naval Medicine, even in the late 1940s. The raft provides the equivalent of a Himalayan or Arctic tent, with double skin above, raincoat and insulated floor and a suit covering. It keeps the occupants completely out of the water, and well protected from the weather. A raft is a much better form of insulation than the best clothing, for it protects the whole body, and the heat produced by all the occupants is available to them all. A fully insulated raft can maintain an internal temperature of 20°C with adequate ventilation in freezing external temperatures. Since the atmosphere in the raft is usually saturated, the occupants do not lose much additional heat if they are wet. With the doors open, the raft is also effective in storming, creating in the tropics. It is also much easier to launch and board under bad conditions than ships, boats and less likely to suffer capsizing. No attempt seems to have been made to document the boats already used for substantial rafting, especially among transoceanic, the number must be large.

Many people will still undergo immersion in sea tropical seas, or exposure in open boats or on land in bad weather. Hypothermia is likely to be a much less major cause of collapse and death in such situations than is drowning or 'choking'. If it is not seriously looked for and correctly treated, many lives will continue to be lost unnecessarily.

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Drift Boats in Rafts, 4 Rafts at Sea in Different Temperatures.

Sea Temperature	Months		Longer Times Survived
	Boats	Rafts	
Below 14°C	1	0	10 days
Above 20°C	11	10	15 days

Fig. 15. Drift cases in boats and rafts after various delays. In column 1, boats; all cases cold; 1

COLD IMMERSION AND SWIMMING

By W. R. Rastings

ABSTRACT

Experiments to indicate the effects on survival after immersion in water of such factors as subcutaneous fat, exercise and clothing are described. The causes of sudden death in water are discussed and advice is given on action to be taken to preserve life after immersion.

I intend to cover the specific problem of survival of people who are immersed up to their shoulders in water and will deal particularly with practical conditions that we believe can be drawn from laboratory experiments.

Many of you will realize that all this research was really started by the report of the Talbot Committee towards the end of the war. That remarkably short report brought home for the first time that cold was the great cause of death after shipwreck. This report and publications in this country by McCann, Ungley, Credit and Widdowson (1955) and Channing (1941) and in the United States by Wolmar (1944) showed enormous interest in the length of time that unaided people survived in the water. Professor Hargis, has already pointed out that fat was probably an important factor and that exercise might have been another. Our first experiments were designed to get some systematic evidence on this, and took place in a small tank designed to take out people and provide physiological experiments under really precisely controlled conditions. The subjects sat on a sliding seat with their feet clipped to the tank, and holding a handle which is on a rope of fixed length so that he can make controlled movements back and forth similar to the breast stroke in swimming. The water temperature is precisely controlled by a thermostat. There is a proper

mounted on a shaft with depth gauges for the water raised onto the subject so that he can be surrounded by water, which stored water all the time. Thus in both trials from the practical point of view as well as the effect of rough water on heat exchange and also accurately measured from the theoretical point of view as being skin temperature, a water temperature. As regards the measurements made we measured rectal temperature where possible, as it is the only reliable measure of nuclear temperature. Rectal temperature was the other primary measurement and was made in every case. Skin temperature was measured and the breathing apparatus fitted as expected or as he collected so that heat production could be calculated. Short flow discs were placed on the subject's skin to measure the rate of heat loss in different parts of the body.

Subcutaneous fat

The first problem to be investigated was the role of subcutaneous fat. There was already evidence that it was important in controlling heat loss from field studies and experiments by Baker and Daniels (1955) and by Pugh and Edmonds (1954) so we set out to see whether fat was the only thing that determined an individual's rate of cooling when he kept still in cold water. If subcutaneous fat is complex in the skin so that the skin and fat simply behave as an even layer of insulation, the type of fat here should be proportional to the reciprocal of fat thickness and there was no heat stored so be the case from the practical point of view. The three people had an average fat of 10 mm. temperature and the fat had practically none. So the effect of fat is very great. However there were some exceptions and two subjects in par-

under were almost equally fat, but one had a much bigger fall in temperature than the other. We measured finger blood flow in these people, and the subjects who cooled more rapidly had a considerably larger blood flow than those who cooled more slowly. Differences in blood flow therefore did account for some of the individual variations in cooling rates, but fat was, as we have already mentioned,

Exercise

The next investigation was on the effect of exercise. We did some systematic experiments on a group of 12 volunteers in water at 20°C, 25°C, 15°C and 5°C. They were dressed up in electronic adaptive chambers. It was found that at 25°C exercise had no effect on the fall in temperature whilst in water warmer than 25°C exercise definitely helped to maintain the body temperature and even increased it, but in water at 15° or 5°C exercise always increased the fall in temperature. This means, of first sight, some preliminary point, what subject to give from the practical point of view. This subject itself with this group of subjects because 25°C is not only the water temperature below which exercise is harmful, but it is also the temperature above which the subjects over a long period could tolerate their temperature more if they didn't exercise. So we are able to say that for this group exercise was never harmful, was always harmful in cold water, and was never beneficial. This left open the question whether matters were different with fat people, and we were lucky to get two rather fat volunteers who volunteered for the experiments. Unfortunately people have the best chance of benefit from exercise in water if they are in water that is just too cold for them to maintain heat balance when they keep still, so we immersed them in cold and colder water until we found the water temperature at which each subject could not quite maintain heat balance

when he kept still. These men's body temperatures fell steadily as we cold the water to 20°C, but the one fatter had to go one water to 5°C before they were unable to maintain body temperature keeping still. When we asked them to work in the water temperatures got too low for them to move then balance when still, their body temperatures always fell more quickly when they were working than keeping still. So when fat or thin people are in water which is cold enough to be a stress to their lives, exercise always results in the harmful.

You may be wondering why it is that exercise should be harmful in relatively warm water but harmful in cold water. It is not due to the fact that exercise produced has had an colder-water, we measured metabolic rate and exercise so far produced much the same extra heat at all water temperatures. Nor was it due to exercise stirring up the water around the subjects, as the subject never kept the same position, the same in both cases. The effect seems to be due to heat in increased blood flow into the limbs during exercise. This produces an increase in the body conduction and a great increase in conductance causes a much greater increase in heat loss if the temperature gradient between the inside of the body and the outside is high as it is in cold water than when it is low as it is in warm water. There is therefore no theoretical difficulty in explaining the effect.

The general conclusion is that people are better off if they keep well in equilibrium or keep on to work, and do not seem about to try to keep warm. The survey we did on the Antarctic disaster showed that most people did try to keep warm by every means.

As Professor Heyser suggested, clothing has very little insulating effect in water, but we found that it does have a remarkably large effect on the overall rate of heat loss. When the volunteers sat still in water

for 28 minutes wearing wetted underwear, underwear warmer, trousers and socks. There falls a body temperature were reduced to about $\frac{1}{2}$ of what they were without clothing in water at 5°C and clothing still had a beneficial effect even when the man emerged.

Cold Induced Vasodilatation (CIVD)

Now to turn to something which may look like rather detailed physiology but is in a point of great practical importance as well. Obviously one is limited in doing experiments in very cold water temperatures. These are definitely unpleasant and indeed one can surmise they can be dangerous too. We calculated that our human subjects had enough fat to enable them to maintain body temperature even in water at freezing point provided the degree of vasoconstriction we had observed in water at 15°C was maintained. However Sir Thomas Lewis had in early in 1910 studied a reaction called cold vasodilatation. If a finger is put into cold water at 0°C you get the usual vasoconstriction at first. Blood flow is cut off to preserve body heat. After a few minutes though the finger blood flow increases again and it then fluctuates up and down for as long as the finger is kept in cold water. It seemed unlikely that this would be of much importance in whole body immersion because the reaction was known to be partly suppressed by general body cooling and probably fully suppressed by severe general chilling. To check this we tried to see what happened in a fat man when we immersed him in water at 5°C . To do this he should have maintained body temperature and he did for about 30 minutes. However after about 30 minutes the finger blood flow started to rise in a typical manner characteristic of cold vasodilatation, heat loss from trunk, forearm, thigh and so on did not show the effect to a marked degree. As the discomfort increased heat loss/body

temperature started to fall steadily and the sensation rose though heat production was increased by shivering during this time. After 35 minutes the heat loss from the finger was increasing rapidly, body temperature was falling sharply and subject became uncomfortable and we ended the experiment. A second subject showed in only the same effect. This effect evidently was only seen in water colder than 15°C . From the practical point of view it seemed that from a long way to explain the beneficial effect of clothing in very cold water although clothing obviously have much insulating effect it does keep the skin temperature some 4.5°C above surrounding water temperature and this is often enough to stop cold vasodilatation from developing. No clothing but a discomfort effect on overall heat loss when you are dealing with these very low water temperatures.

Now for a brief theoretical discussion of the cause of cold vasodilatation. We observed evidence that it was due mainly to direct cold paralysis of blood vessels in the skin. The parasympathetic is interfering one in that it involves a very early stage of the interaction of vasodilatation with the cell membrane. The latter steps and the functioning of the autonomic system could not be studied. It is not possible that by adapting in the man to repeated cold immersion in very cold water the blood might be modified and he might regain the ability to maintain control of his blood vessels at low temperature. We would think by able to survive comfortably in icy water as seals and whales do. Finding that natural processes in essential it even for men are to survive long in arctic waters.

Further Incorporation of evidence

I want to leave this whole question of hypothermia now and go on to something which is less relevant to the Navy on the open sea but which is more important to

anybody who is concerned in taking in cold water, and I suppose routine spinal operations. This is the question of sudden death in the water. On the one side death from hypothermia is the great hazard, but people who die in inland waters probably do not die from hypothermia. They are either usually rescued or able to get ashore on their own from an inland swimming, but here they are in serious danger from hypothermia. Traditionally accidents of this sort that cannot obviously be explained by drowning are usually put down to cramp or to exposure of water into the back of the head causing reflex spinal arrest of the heart. We became interested in this when a subpostmistress at Oxford who was an extremely good swimmer died after a sailing accident on a reservoir. He tried to right the dinghy without success and decided to swim the 50 yards to shore to get some help, but after 30 yards he decided that he couldn't go on. He sank and his body was recovered the next day.

A possibility that we considered a first was that people might get myocardial infarction in these circumstances. We did get some evidence that this might happen because we always had an electrocardiogram going during the cold immersion studies and traditional ventricular ectopics were shown on the trace. They were quite common and came on early during immersion, starting about 30 seconds after immersion and often disappearing after about 2 minutes although the subject stayed in. In several cases we knew what was likely to be happening in the circulation that might produce these arrhythmias and increase blood pressure and perhaps release of adrenaline and we did some reduction of adrenaline experiments on ourselves to get more information. They showed that on water immersion, gastric or arterial cardiac output as well as arterial pressure. So there was a large increase in cardiac work, which seemed enough to ex-

plain the incidence of ventricular ectopics during this time. The respiratory tract showed that there is also an increase in depth and frequency of respiration both the volume and the frequency of the breathing increased. This disturbance in breathing could itself be a major hazard to somebody who is precipitated into very cold water unexpectedly as breathing could then not be controlled voluntarily. If you suddenly go under the water or cough water up into the nose then during this time you will almost certainly choke with water and could then drown very quickly.

In any case the ventricular ectopics suggested that myocardial infarction might account for the rash cases in which people normal people have dived into a swimming pool and just floated to the surface dead. But this is certainly rare.

However, we still had the problem of what kills people apparently quite frequently when they try to swim in very cold water. In the end we decided to do some direct experiments in cold water to see what happened when somebody tried to swim in very cold water with clothes and without a lifejacket. We first swam in water at 20°C in an outdoor swimming pool without any difficulty. The same people then tried to do the same in water at 4.7°C in an outdoor swimming pool in winter. The first man was a champion swimmer but he was surprised he suddenly got into difficulties and went down like a stone after 30 seconds. Although he was only 14 from the side of the pool he couldn't even manage to grab for the side. We of course had a rope round him and pulled him straight out. The others swam for rather longer but some could swim as long as 11 minutes. (A. This was the course of the actual experiment.) The first shows one of them gradually getting into difficulty and getting too exhausted to swim after 7 minutes. The body temperature did not fall and at the end of the 7 minutes was

will exactly the same as it was at the beginning. The fact that he was not hypothermic also stemmed up from the fact that he was perfectly normal a minute or two after sunset. The only reason he could give for the collapse was exhaustion. The more reason is just wanted to be the high viscosity of cold water interfering the work needed to produce swimming movements and helped by the respiratory drive from the cold. It is difficult to say what it is that makes somebody collapse from exhaustion. The latter people were able to swim for rather longer because their body stay chilled them to make more gentle movements and keep their head above water for very much longer without exhausting themselves, but after 10 or 15 minutes they too had to give up.

Advice on actions following accidental immersion

I should give some sort of assessment of how important advice may be on this subject. It might be felt that some of the advice is obvious, that anyone who goes out in a dinghy in winter-time ought to have a lifejacket. To a large extent, sailing clubs do give advice now along these lines, and usually advise people to wear a lifejacket at all times. However it does seem worth making the particular point that even people who are extremely fit and extremely good swimmers are in danger if they sail in cold waters in winter-time without some sort of buoyancy aid. Certainly anybody who goes out regularly in this sort of situation ought to be advised to stay with the boat if they possibly can and let somebody rescue them; there is almost always some sort of rescue service as long as an offshore accident. The other question is what to advise people to do after they wreck. When we questioned the Japanese survivors, we found that the great majority had taken off clothing before going over the side or had attempted to put cloth-

ing on even though they had wet, and had survived in the water although they could have floated well. There seems little doubt that in accidents of this kind many deaths could be avoided if people were advised to put on heavy clothing before their life jackets, and then to keep well near the ship until they were picked up.

Freezing injuries

One point that I am touch on is the question of actual freezing of the skin in summer. The freezing point of seawater is -1.9°C and this will be the temperature of most waters where there are ice floes about. In water at -1.9°C the fingers can freeze solid. They don't always do so at these temperatures, reported but we found that the first freezing point of skin was about -0.5°C and that our fingers usually froze if put into freezing seawater at -1.9°C , particularly if they had previously been in contact with fresh water that would provide a focus for crystallization. Hence, all people freezing solid in Arctic seas in the last war were generally documented as emigrants, but I suspect that a lot of them they have been wet and with ice simply due to people mistaking the difference of cold lands for freezing.

Acknowledgements

I would like to acknowledge the help we have received first from the experts who volunteered as subjects. Most of these arrangements involved very appreciable risk but a lot of them were great sympathizers. Dr M. Kline, and Dr F. Cullen volunteered on the work in Cambridge. Dr M. B. Williams at San Francisco, Dr J. Magill and Dr K. E. Cooper at Oxford, but while all of us acted as subjects for some experiments the most volunteers were recruited for the experiments, both exchange studies. It was largely due to Dr U. F. Ellis that they were released from their various jobs. I would like to thank the Medical Directors

General who backed the work and Professor B. A. McCance who was head of the department where the last challenge work was done and was also the Chairman of the Survival at Sea Subcommittee.

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COLD/WET EXPOSURE ASHORT

B. B. G. Dalgleish

SUMMARY

A personal description of the effects of exposure and consequent hypothermia, and its dangers. Detailed advice on treatment, both standard and preventive, is given.

You will probably know that speakers come in various varieties. You have men of the tall speakers and expert or specialist speakers and yesterday you were lucky enough to have some of the latter among our guests. Well, I have to tell you that there is a third class and that is the substitute speaker and I am one of those. You should have heard Griffith Pugh. But unfortunately he is in hospital and so I have been asked to fill in the gap. When I have to fill in as an entirely practical book, good as my only qualification and that qualification is based on my experience in the Antarctic.

I have been there twice. The first time was meant to be for a year with Sir Vivian Fuchs and we were going to do a survey of the Gamburtsev Coast which is due south of Cape Flora. We did the survey and at the end of the year we packed our bags and were ready to go. We talked to the ship on the radio and the ship went by and the weeks went by and eventually the ship came up on the radio and said: Well, we're awfully sorry about it but we can't get in 150 miles of ice so we'll go but never mind we will come back next year. So we had another year with no further mail, no newspapers or news food but we survived very, well and, in fact, did some very valuable work.

Two years later, having enjoyed that first experience very much, I went again

this time for only a year. Well, what I find the first time was easy. Let's see, we survived here we were much fatter by then and experienced lower temperatures. We found we had being -50°C (-58°F) and we worked down to -43°C (-54°F) that is not just an arbitrary temperature because it is at about -40°C that you get frost forming inside your mechanical items and so we could then stop work with a clear conscience. I have slept for a day or two in the snow on very very low temperatures, the lowest being -41°C (-42°F) and you get winds which blow up to 60 knots and gusting up to about 100 knots. They can last for some time, the longest I think I experienced lasting for about one week.

Now the last, I have professed for you will not be in any way small point but one dropped nearly for the General Dental Officer and I hope they will be of some assistance. We have all been extremely interested to hear and to meet Professor Harvey and Professor Keville and to hear about the work they have been doing. These papers were of tremendous value because until fairly recently the approach to the treatment of exposure was very much what would be regarded as common sense and many of the things that were recommended in the past were suspect, partly if not actually harmful. Very few doctors have ever seen exposure, they can only hear about it from other people or read about it and these ideas of treatment, not surprisingly, is small.

One of the problems mentioned yesterday was that of obtaining people in the

difficulties, and perhaps I should mention one more. The Medical Officer General told us of a conversation he had had with the Norwegian Medical Officer General and I absolutely agree with the statement that breathers should be a portable device for our own equipment except for very unusual circumstances and accidents which our medical budget for at the time our breathers should be merely prevent that it is almost a self-inflicted injury. I have found it difficult to bring this home to non-specialists, but about four years ago I had unfortunately at usually much trouble to bring people to their senses two Army units died from exposure on Dartmoor. This shows how important it is for all engaged in this sort of business to have a knowledge of the signs and symptoms of exposure.

The Problem

What is exposure? Well you heard first it is correctly called hypothermia. It is a state in which there is a fall in body temperature which results from the heat produced internally by the body no longer balancing the heat loss and it is important to remember that this can occur independent even in the healthy. In 1966 Pugh produced a very interesting article in which he reported on the 15 deaths that resulted from exposure in Wales the Lake District and in Scotland. Typically three cases occurred in foot wearers, probably with insufficient clothing which generally became wet. It is not frequently the victims of the parties point. The discovery walked plus the height climbed had been incorrectly assessed and in the witness and evidence was added explanation. There are other factors which we have heard about the thickness of the person and their susceptibility and if there is oxygen lack, in high altitude then the symptoms will come even more quickly. But you don't have to go to the Poles and Lake District to have cold exposure. There

is a very interesting article by Cohen (1964) in the Practitioner who reported on cases of cold injury requiring amputation involving 10 people in London. One of the men got himself locked in a large refrigerator so that whilst sitting sleeping the other five, which I found most surprising, were all stamps who had got their cold injury as a result of sleeping in grass—this is a habit I have not heard of before!

In 1960 Kravitz (1961) who first showed that of the 124 deaths from the Antarctic 115 were due to numerous hypothermia and this led to a great deal of interest among sailing masters, especially when they heard what the temperature of the water was when it was and how close a time the casualties had been in the water. Professor Harvey has stated that lightly clothed men would not last more than 15 minutes at 8°C. My own experience of immersion in sea water occurred in the end of my first two years in the Antarctic Base of as Fuchs, myself and two others had been looking up in principle taking out the valuable equipment, actually took some preparation and was in fact of the people. It was one of those incredible days which you can only get in the Polar regions when it was absolutely calm still and the sea was completely clear, you could look down Fuchs and see the bottom. We were wearing salopettes, our jackets and wearing rather gaily after looking up these heavy boxes on to the walrus. After the plane had left we had a sense of disappointment that our first contact with the outside world for two years had gone and we looked around and the witness. I looked at Fuchs and the water and said 'Clark it makes you feel like having a swim'. Yes it does doesn't it. Well all right I will if you will'. Then we moved away the snow, headland and stepped off all our clothes and walked in. I was the first one in pushing the sea from under and I got up to about my chest depth and then walked out much

water and can stand on the shore. The water temperature was about -11°C , we didn't like the temperature but we knew it better, the sea water was freezing over night. It was a very embarrassing experience both physically and psychologically and something to think about!

Signs and Symptoms

A couple of years ago I was at the Naval College at Dartmouth and I used to lecture to the cadets on exposure hazards they did the practical Leadership exercises on Dartmoor. To try and put a warning to them I used to take the effects of cold on the body as an universal combination sign or warning as a colder and colder environment until the coldest then and the machine starts up. I know that is not exactly true but General Daters Medical Officers have got to get the idea across to people without any specialist knowledge and it is quite a good result.

What are the signs and symptoms? There is no dramatic sign or symptoms in which I as anyone else could put a name. You don't go bright red or white or even green and the most important sign I experienced was abnormal behaviour. This is why it is very important that the person going to change of young men should be someone who knows them well because this abnormal behaviour is to me the most real sign or symptoms of the lot. You will probably get scratching unconsciously or pronounced uncontrolled shivers or quivering, you get a slowing of the pulse a stumbling, a loss of interest, shivers will more seriously a sensation of shivering. All the old progress or responses are total responses and an inability to control the work. There is probably only an hour or two from the onset of the warning signs to collapse and the collapsed person if unassured will become unconscious and death will come in about 2 h later.

I can best describe some of the symptoms by a personal experience of my own

found by very rapid cooling. I was quite personally nearly struck in the chest area and we had had a wet, blustery day driving our dredges with one, broken. This is hard work, you don't just stand there looking attractive in your fur lined overcoat, you drive all over the place and they are very large, goes up to 1500s each. You have to control your dredge (more so than you had) I was had on it and stay on most days at the same time. It was so cold you couldn't have ordinary hand breakings, you had to have self breakings and there had to jump into them and stay on them and jump out again to deal with the dogs.

It had been very hard work the previous day and there had been a lot of pulling of the dredges as well as pulling by the dogs and a lot of turning the engine and I reacted probably from the heavy physical work. When we stopped to camp that night the broken man killed a seal. He had arrived 14.30 minutes before us and had killed it to feed in the dogs. There was very little wind that the air temperature was about 11°C (53°F) and as the notion of setting up the camp proceeded I became progressively colder. My first idea dogs, they thought a lot as they observed us when they have fresh meat and I became colder still. Someone then asked me if I would make up (Dartmouth) who was a very good head dog, the best we had who had been involved in a fight and had got locked around. I found myself replying 'Oh better Dicks' although it was somewhat stronger than that. This was unusual because we all had tremendous affection and respect for our dogs but now our lives depended on them so there was an up. This was not clear water who was an abnormal behaviour. By then my shivering had ceased and I knew through a consciousness wanted and shivered that I was carrying out the unconscious work slowly and slowly. I felt extremely tired and found my self thinking how nice it would be just to

be done for a while and this is the point at which it is necessary to have the will to survive. I can quite understand people dying. I have read accounts of other people's experiences when they have been sent to death from cold it must be a marvellous death: a very peaceful and comfortable way of dying and I know I had the tremendous desire to be done and up in a corner and have a quilt put on to be put away from all these things which made me uneasy and unstable.

I did at first notice when was happening and I stumbled into the tent, much to the surprise of my travelling companions who knew that I couldn't possibly have achieved all the tasks that were necessary when setting up camp. Inside I removed my windproofs and this is a very important point to remember no matter how cold you are. It is very easy to begin a windproof as effectively keep the heat out so they keep the cold out, they are a temperature exchange barrier not many at the time I have seen somebody standing shivering their feet for a stone to try and get warm when they still have their mitts and windproofs on. We got the frozen covering away made that went in and I began to tell you that I had a cigarette because I used to smoke in those days. So within 15 minutes or less I was going normally and I returned outside to work up. Darker and to finish the other tasks. My mistake had been to wear too much so that when I stripped my physical covering I was covered in sweat and with the temperature at -17°C (-31°F) it suddenly froze all over me and that is a very good way of cooking yourself alive!

Treatment

Well what happens if you find someone with exposure? What you have to do is to remove the process and warm him up. Usually you use a warm bath at $40-44^{\circ}\text{C}$ which must be kept at that temperature by adding warm water until the patient has

recovered his normal temperature. Blisters being uncommon on mountains and since you have got to be well approximated to the process as much as you can. You should look out for chafes or frost or blisters. Remove the patient's windproofs and all his wet clothing (which is not doing him any good for a long time) and then say that you are virtually naked when you are standing in a strong wind is not clothing! Put him in a sleeping bag perhaps with wrapped up heated bricks or perhaps with similar provision which has been done many times very effectively. Cover his feet if you feel that the wind is chilling him and he is losing heat from there but don't rub his feet as they are already partially frostbitten. Don't put him straight. I have often wondered how many people have been killed by the frozen dogs. After all that you can consider moving him and it is worth remembering that undoubtedly people have died having had all the correct treatment because they have been moved during the mountain foot fall and have suffered cerebral anoxia.

Better than treatment of course is prevention. This is achieved by wearing proper windproof and waterproof outer garments. Wearing the sort of clothes we worked in temperatures down to -30°C and it was possible to work quite happily all day. It was heavy physical work but you didn't stop because then you did get cold. At the end of the day you would find the inside of your trousers completely covered in frost which had formed from your perspiration, that notwithstanding, you felt quite comfortable.

It is important to have adequate replacement of dry stone garments which is not at all difficult these days with the advent of the plastic bag and you must always budget for the worst weather conditions. Many of the mountains reported by Pugh (1964) in his article showed that people just estimated that it was going to be fine or hoped that

it would be that we didn't even bother to think about it at all I suppose. The best bit of advice I have ever given to anyone going to the Polar regions was that if they wanted to have a good chance of survival and you are literally fighting the elements they must never take anything for granted but always budget for the worst. Always at the pace is not the slowest member of the team and obviously all members must be instructed to recognise the early signs and symptoms of exposure and how to treat it.

A summary of symptoms to recognise the various, contains quickly no alcohol and no smoking. I do think it is useful to tell people that alcohol doesn't warm. We found in the Antarctic, the opposite of what our finds in the tropics, where you can

drink like a fish, with little effect because you are better just up and swallow you need the food replacement. In the Antarctic we would have one bottle for every 11 of us as a mark, which meant one good measure each and it had a very strong alcohol content. It does cause some discomfort but it also gives a feeling of euphoria which I think is absolutely dangerous in a place where you should have all your wits about you.

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THERMAL BALANCE IN DIVERS

By J. S. P. Rawlin

(UK, 1961)

Factors affecting the thermal balance of divers are discussed with particular attention to the effects of 'wet' and 'dry' suits, methods of heat replacement, and factors contributing to heat loss.

Introduction

Divers are tough individuals whose training and selection are rigorous and result in men accustomed to work under adverse conditions. One of these conditions is, cold and used secondly a measure of a diver's competence was his ability to withstand cold. His only protection was the insulation of his diving dress, whose bulk was limited by the nature of the tasks to be performed. However in these recent major experimental dives James Webb and Frank M² could obviously outlast the divers, and in Weight III cold may have been a prime factor in the death of one of the divers.

Those of you who have undergone a diving course at Bournemouth in winter where the water temperature falls to 3°C (37°F) or who were involved in the aircraft underwater escape trials at the Admiralty Hydro-Physics Research Establishment Gosport will appreciate how cold diving can be.

It was one of the Gosport team Captain E. L. Holman MC 1959 who was assigned the task of continuing with a subjective study and on return to the UK began work on thermal protection of divers observing that some or four people other than professional divers—signallers and engineers—would require to go down into the depths in early war

times and make observations which could not be accomplished at second hand.

These studies were initiated in the Environmental Studies Division of the US Naval Medical Research Institute Bethesda Maryland USA.

Immersion Studies

Berkman started by observing the response to cold of nude subjects immersed in water at different temperatures. It was soon apparent that

- 1 Thermal balance cannot be maintained even in water at 24°C (75°F)
- 2 the response to cold is extremely variable

Myrback, who may survive, drowned, or follow a suicidal course. Rate of heat loss is equally variable. Subject immersed at 24°C (75°F) lost heat at rates varying from 60-180 kcal/hr./sq. cm. Heat loss was not necessarily related to body fat, the subject with the highest heat loss having almost exactly the same proportion of body fat as a subject with one of the lowest heat losses (Holman, Rawson and Clouston 1961). Tolerance times for immersion varied from 3-11 hours and could not be predicted either from rate of heat loss or from percentage body fat.

Because of wide variations in response, large numbers of tests would be required in order to obtain statistically meaningful results. Even then there would be no guarantee that they would apply to a given test and for a diver who has so many other problems to contend with a wrong assumption of tolerance based upon a statistical probability could be disastrous.

Insulation

Bellman next turned to thermal insulation. He found that even with one inch of foam neoprene insulation it was impossible to maintain thermal balance at 4°C (40°F) water (Bellman *et al.* 1950). Since such a suit would be quite impractical, the solution would be to use a thinner suit together with some means of supplying supplementary heat.

Various heating systems were investigated but difficulties again arose in such suit and warming systems because of the variation between test subjects in their response to cold. Progress was made at last, at a standstill when my colleagues and I took over the work.

A Mathematical Approach

The language of mathematics, which we adopted, was based upon the philosophy that if a man could be kept in thermal balance the physiological problems of cold could be bypassed (Raymond 1957). It is a matter of applying the basic laws of thermodynamics.

The basic equation is:

Heat In = Heat Stored + Heat Out
 Isothermic man does not normally store heat but balances his diet and respiratory heat loss by metabolic heat generation. For him the equation can be simplified to:

Heat In = Heat Out (Heat In representing metabolic heat generation)
 In the case of the heated diver the basic equation becomes:

Metabolic Heat + Supplementary Heat (Gas-Heat Replacement) = Respiratory Heat Loss + Skin Heat Loss (Conductive, Radiant, Convection and Evaporation) (Ratches, Bensch and Leathers 1965a).
 For dives down to 18 fm (60 ft) Metabolic Heat Output and Respiratory Heat Loss are small in relation to the other factors and for practical purposes can be ignored.

Heat Balance Equation

At the Naval Medical Research and

Development Command we developed a mathematical model describing the simplest heat balance around a diver, the diver being in thermal balance. The model was simplified during the study of the mechanism of heat loss and involved some 20 terms including thermal conductivity and heat capacity of neoprene suit and water, water velocity, differential temperatures, Reynolds, Prandtl and Fourier numbers and so on. As a result we were able to predict the heat replacement requirements for a diver wearing any garment of known thermal conductivity for any work rate and depth in any water temperature and breathing any gas mixture. For example, a man wearing a 3/16-in. foamed neoprene suit in 6°C (43°F) water breathing air at 1 dm (12 ft) would require 1290 kcal/hr (5380 watts) when at rest and a further 450 kcal/hr (1900 watts) when working.

Experiment and Check

The next step was to check the predictions by means of a series of steady state experiments, using both wet and dry suit configurations with a variety of heat up systems. Steady state was considered to be achieved when:

1. deep body temperature was constant at around 37°C (98.6°F);
2. mean weighted skin temperature was constant at around 34°C (93°F);
3. heat input to maintain steady skin and deep body temperature was constant within narrow limits;
4. the diver was subjectively comfortable.

The beauty of the steady state approach is that very few subjects are required, and once steady state is achieved there is no need for plotting the experiment. Obviously the subject will remain in thermal balance so long as his heat supply is maintained.

Heat Heat Limit Wet Suit

Skin heat loss is a complex function

Basically there are two types of wet and dry. Wet suits are usually constructed of closed-cell foamed neoprene (Hibon) proved of various thicknesses. The layer of water which seeps beneath the suit rapidly warms up and becomes part of the insulating layer.

Advantages are good insulation in short hot dryish weather and low drag when swimming. Performance of the suit is relatively unaffected by small holes and by cutaneous diseases.

Disadvantages mainly arise to one of the suit for deep and minimum diving. Pressure results in shrinkage and loss of neoprene so that at a depth of 30 fm (100 ft) where the pressure is 4 A.D.A. shrinkage is reduced to about 50 per cent initial shrinkage (Fig. 1). In a helium atmosphere expansion takes place slowly but only reaches about 60 per cent initial shrinkage. The helium progressively escapes when the diver returns to the water. This suits also suffer from the disadvantage that water seeps in and out of the suit with every movement including respiration. The amount depending on the fit of the suit. This is the reason for the extra requirement for supplementary heat when the diver begins to work.

Suit With Loose Dry Suit

These depend for insulation upon a gas trapping layer of foamed or syntactic film



Fig. 1. Effect of pressure upon wet suit.

or open cell plastic foam with a particle of impermeable neoprene cover it. The thickness of the insulating layer is measured at depth by releasing gas into the suit and released.

The efficiency of a dry suit depends on:

- 1 Thermal conductivity and heat capacity of the insulating gas.
- 2 Efficiency of the undergarment in the retaining gas movement.
- (3) Retaining the pressure differential which exists between the pressure of the head and the water at the feet of a diver connected to the open's surface.

Foam and carbon dioxide have almost equal physical properties for insulation and the latter has the advantage that it can be easily scuttled. The ideal undergarment suitings to be developed. It should contain moisture gas trapping with flexibility and resistance to a pressure of 3 psi.

The advantage of the dry suit is that efficiency is relatively unimpeded by depth and there is no flooding problem.

The disadvantages are that neoprene is shallow water is less efficient than that of foamed neoprene and neoprene is severely reduced by leaks, tears and distress.

Impermeable Suit

Some of the problems of neoprene can be overcome by simple modifications to the usual configurations, for example by wearing a sealed (dry type) foamed neoprene suit or by using a wet suit as an undergarment beneath a conventional dry suit. A theoretical solution is the impermeable wet suit the insulation of which is unaffected by depth. But technically a lot is far proved difficult to achieve an acceptable garment.

Wet Replacement Systems

We examined three systems:

- 1 A wet suit corresponding a matrix of diaphragm membrane units.

- (2) a heat-exchanger with a network of fine tubes containing a closed circuit warm water heating system
- (3) a free-flowing warm water system

The electrically heated unit (Fig. 2) were housed in 1/4-in. stainless-steel unit was designed for shallow water operation and delivered about 1000 kcal/hr for 6000 watts. The closed circuit unit was run to maintain a flow of 9 l/min (2 gals/min) at 40°C (104°F) gave an output of 1290 kcal/hr (1500 watts). The free-flowing unit of 1/4-in. stainless-steel was the simplest and most comfortable garment for most diving trials. It required a flow of 10 to 1 l/min (4 to 2 gals/min) at 45°C (109°F) which for 100 to 6000-l depth could be achieved by means of a heater at the surface delivering water at 51°C (124°F). The losses in the hot water lines were surprisingly small.



Fig. 2. Thermal balance suit.

Power Sources

The electric unit could be supplied from a surface supply or be self-contained but noisy. The closed circuit unit could be supplied from a heater at the surface from a heater/pump located in the habitat or personnel transfer capsule (PTC) or from an individual heater/pump of some sort. We even evaluated a motor powered heater/pump based upon platinum 128. Neotrex and gamma neotrex limited us not to 30 hours per year and a cost a quarter of a million dollars so that it was not a very practical system for regular diving (Tucker, Easdale and Beach, 1970).

Habitats, etc.

I referred to the Israeli ID accident. For a diver at work at depths at some of 150m (492 ft) it is essential to use a saturation diving technique. This is based on the principle that once a man's tissues are saturated with inert gas, his decompression time for a given depth becomes independent of the duration of his dive whether it be days, hours or weeks. Saturation diving systems must supply underwater habitats such as Satlab in which the divers live at the ambient pressure so the ocean floor or surface support systems wherein divers live under pressure in a chamber at a surface depth travelling to and from their work in a PTC. The breathing mixture is delivered by the depth and for dives at some of 180m (590 ft) it is over 40 psi wet helium.

Habits

Helms has not taken the thermal suit seriously so, since the specific heat and weight the density and the water viscosity are at the surface. Pressure merely affects thermal conductivity but heat transfer properties remain directly with density, and at 324 kg (71800 lb) helium is less dense as done as air at the surface. Thermal conductivity and density combine to cause heat transfer by convection, conduction

and at 300m (1000ft) the temperature rise (delta t) is about 30 times that of air at the surface. Hence to keep a diver in a habitat or PFC in thermal balance at this depth it is essential to maintain the atmosphere at a temperature closely approximating the preferred mean skin temperature of 34 C (93 F). At 300m (1000ft) it should be 31 C (88 F).

Gas Movement

Externally conductance is also greatly affected by gas movement. Scuba *divers* complained bitterly of the draught created by the CO scrubbers in the PFC. We calculated the heat requirement to maintain a diver in thermal balance in a PFC at 300m (1000ft) at a temperature of 4 C (40 F). When the gas velocity was slightly raised from 0.3 to 0.9m/sec (10 to 30ft/min) the heat requirement rose from 1.117 to 1.166 kwh, or 10.200 to 1.055 units (Thibaut et al. 1959b).

Humidity

Humidity determines evaporative heat loss from the skin and respiratory tract. In 100 per cent humidity there is no evaporative heat loss. However humidity also contributes to a thermal conductance (which is why a damp day feels so much colder than a dry day at the same temperature) and this effect under deep habitat conditions is a noticeable on-effect on heat and evaporative heat loss.

Habitat humidity should be 60-82 per cent RH (Ravenscroft 1967).

Radiant Heat Loss

If a temperature gradient exists between the diver's skin and the wall of the habitat or PFC he will lose heat by radiative convection of the temperature of the atmosphere. Since thermal balance is so critical at depth, radiant heat loss needs to be controlled by isolating the habitat/ PFC wall at 32-37C (90-95 F) at 300m (1000ft).

Respiratory Heat Loss

It was stated earlier that respiratory heat loss (RHL) could be ignored as shown in 150m (500ft). Webb and Jones (1960) measured RHL with helium meters at depths down to 300m (1000ft). Fig. 3 shows an extrapolation of these calculations and compares respiratory heat loss with depth for 50 per cent helium mixtures at 0°C (32°F) with various ventilation rates.

Note that at 150m (500ft) RHL at a ventilation rate of 37.5 l/min (137 kwh/hr (32)) would be an approximate the mean body heat input for this level of activity. As the work-rate and hence the absolute heat output increases, ventilation increases and so does RHL. Hence at 150m (500ft) RHL approximates metabolic heat output at all levels of activity. At the lowest depths metabolic heat always exceeds RHL, at greater depth the reverse obtains.

RHL results from:

- (a) Heat loss on raising the temperature of the expired gas towards body temperature.
- (b) Heat loss as heat of evaporation of the expired gas, raising the inspired gas to be water-free.

At 300m (1000ft) at a ventilation rate of 50 l/min the predicted loss is over 400 kwh/hr (1000 units). Such a loss rate might not be made up by supplying heat to the skin. It might cause tissue damage.



Fig. 3. Extrapolation of Webb and Jones (1960) data.

definite circulation of space in the upper respiratory tract.

Experimental Check

Trials were set up to establish the reliability of these measurements. Helium was sent pooled to 1°C (34°F) was bled into depth dives to 300m (1000ft) at various ventilation rates induced by work on a bicycle ergometer. The results:

- (a) confirmed that at 100m (3000ft) RHL approximated mean body heat lost per unit
- (b) showed that at 240m (800ft) even very deep body heat loss occurred despite an ambient temperature of 10°C (50°F). One subject's deep body temperature fell 1.8°C = 3.2 hours
- (c) confirmed the danger of a massive heat exposure. One subject was re-exposed after 34 minutes at a ventilation rate of 45 l/min by a massive environmental radiation from the upper respiratory tract which forced him to disrobe his wetsuitcase. In an actual dive this would have proved fatal.

It is a matter for speculation whether this might have happened to the *Shahid-61* diver who was found by his compression measurements approximately with the mouth part of his face being separated out of his mouth.

Analysis of the data showed that:

- (a) At 300m (1000ft) breathing the same heat conductivity (9% per cent helium) at 10°C (50°F) at 45 l/min there was a 44% of 41 kcal/hr (98 watts) 95 per cent of which was due to latent heat of evaporation.
- (b) At 300m (1000ft) breathing 9% per cent helium at 1°C (32°F) RHL was 708 kcal/hr (980 watts) almost exactly what was predicted.
- (c) At 280m (1000ft) despite a 30°C (86°F) ambient temperature was subject's deep body temperature fell

1°C in 1 hour

(Hoke, Jackson, Alexander and Fenn, 1971)

Hoke, for deep dives below 100m (300ft) in cold water, it is essential to heat not only the skin but also the inspired gas.

In a further experiment the inspired gas was heated to 14°C (57°F) during a work load was done to 300m (1000ft) at 1°C (32°F) water (Hoke et al, 1971) and preliminary calculations suggest that this was adequate for comfort. However his design and longer dives a more precise control of gas-heating may be necessary and the temperature of the inspired gas may have to be related to the ventilation rate because during the first experimental high dives inspired of desiccation when working hard and breathing gas at the wet heat temperatures of 38°C (100°F) a wet pressure which was entirely acceptable for their normal activities.

Conclusions

In December 1963, real temperatures were recorded on 15 men undergoing diving training in Honeys Lake where the water temperature was 4°C (40°F). Dives lasted 30-60 minutes and dive suits were worn with a variety of underclothes. Temperature recorded five minutes after leaving the water varied from 36°C (96°F) to 34.5°C (94.1°F). In order to raise the temperatures were below 34°C (93°F) and at five it was 33°C (91°F) or less.

The under suits exhibited symptoms of severe hypohydration and hypothermia. One had signs of early cold injury at one hour. One collapsed and had to be taken from the water as had a previous trainee whose collapse and loss of consciousness due to cold had delayed the investigation.

The situation of the *Flora* was drawn to the possible risk of insufficient underwear and to the importance of checking the subject's temperature in all cases of diving injury.

These observations highlight the danger:

of hypothermia is during the rapidly of its onset and the unpredictability resulting from the wide variations in the response to cold. It will be obvious that if hypothermia catches occurs in situations where there during during towing the outboard for the diver is extremely grave. This is particularly so in the case of sport divers and commercial free-divers who tend to have a much less disciplined attitude to diving safety than naval divers.

Accidents can be avoided if the threat of hypothermia is fully appreciated, and for prolonged or very deep dives there is now an excuse for failing to maintain the diver in thermal balance.

Fred Anderson the creative brain writer once said 'I have yet to meet a problem, however complicated, which when looked at in the right way did not become even more complicated'. He was not the problem of achieving thermal balance in divers, when looked at in the right way is capable of a beautifully simple solution.

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ADAPTATION TO COLD AND COLD INJURY

By J. D. Naiman

Abstract

The possibility of acclimatization to cold is discussed. The normal adaptations and reactions to cold is described both physiologically and generally, together with the pathologic and treatment of frostbite.

COLD ADAPTED RESPONSES

Whole Body Adaptation

Acclimation evidence can be used to point strongly to the fact that a change occurs *only* when exposed to cold, in that, over the course of days or weeks they are much less affected by the cold than at first. Polar explorers, who have survived accidents often just the type of accident as for example in the various journals of the Franklin Searches. The story usually emphasizes an initial misery and sense of progressing towards a cold death, suddenly reversed after some days into a sense of calm with the environment and apparently noticeable survival ability thereafter. This is seen in its clearest form in a work of documentary reporting by Horvath (1954).

During the 1930's and 40's a series of experiments went on parts of the world in which the indigenous inhabitants suffered cold exposure during the winter season (Munro, 1953; Irving, Anderson, Boland, Elmer, Willey, Leving, Naiman, Payne and Winkley, 1948; Anderson, Leving, Naiman, Willey, Fox and Boland 1949). By measuring the metabolic heat production over temperature skin temperatures and in some cases EMG and EEG during the course of variable unprotected days at ground 0°C or temperature still lower, were sought from the diaphan-

dering, insurable pattern of normal non-acclimated Caucasian subjects. The more studies that were undertaken the more confused the initially simple picture became. But if it is possible to summarize these experiments at all, it can be said that two patterns of response to whole body cooling exist.

- (a) The Insulative-Hypothermic response. Characteristic of Arcticized subjects in which a low metabolic rate and low rectal temperature is combined with a low skin temperature. The subject feels without discomfort and his Newtonian heat loss to the environment is maximal.
- (b) The Muscular Normothermic response of Caucasians consisting of a high metabolism (shivering) high rectal temperature and high skin temperature (except for the feet).

In the non-adapted it would appear that skin vasoconstriction must be relaxed for sleep to occur and in general the non-adapted subjects always had a terrible night while the cold adapted subjects slept peacefully, awaking like herds of horses next to the morning.

Apart from the recorded evidence it could well be argued that there is no clear justification for the concept of whole body acclimation to cold. I must declare my own belief that it does, however even as a physiologist more difficult than that of more biologists (trying to write cold down) and that it is within the adaptive range of comfort non-acclimated people like ourselves. Wiggins, if they could be found without other degenerative due to their

is it of his, which is the most likely explanation for studies in this regard.

Local Tissue Adaptation

Various specific adaptations of tissues have been demonstrated in animals and a few in man. Nerve conduction is poorer at the tip of the gill fin in the cold adapted animal at lower temperatures than in the warm adapted. The melting point of peripheral fat is lower in the distal than in the proximal parts of the leg in Caribbeans, and in human caudates.

It is possible to look at the cold induced vasodilatation (CIVD) response in cold adapted peoples. This is seen to be earlier and more pronounced in the Lapps than in control subjects, and the same response is seen in the case of Arctic Red Indians versus controls (Claret-Nelson and Irving, 1982). Hansen's lower limb Indians in Fleetwood 1 according show precisely the same response and are clearly different from the average British population in this respect (Malm and Sjöström, 1982).

The evidence for tissue adaptation seems more definite than for the whole body and the advantages in conducting said experiments always. However two other points may be made. First, no one has yet succeeded in showing acclimatization actually occurring. Thus we can only speak of the unacclimated and the unacclimated, and can only speculate on whether the difference between them occurred in a series of prolonged cold exposures. Second, in the context of this Symposium it would be well to mention that a fish which would be far more at risk to the post-diplothermic cold immersion anoxia, which Professor Knäuper has described for the early CIVD, would lead to a massive heat loss from the brain and hence an earlier death from cerebral body cooling.

RESPONSE OF THE HAND TO COLD Group Cooling Curves

Although we are not, from this point on

looking for similar evidence of the fish support system, it is worth noting a late and somewhat subtle but human population difference in the rate at which most hands cool or rewarm during work. For example there is now little doubt that people at supra-cold show faster hand cooling, and a greater risk of cold injury than do the white skinned. It is well to remember this knowledge when there are taken out for adventure training Eskimo handworkers. Hands have been shown to commence rewarming some minutes before those of similarly cooled students during studies in Scandinavia.

The Normal CIVD Response

This is influenced profoundly by at least two major factors. First, general body cooling and delay the onset of vasodilatation presumably by increasing the general vasoconstrictor drive and preventing the release which occurs in the autoregulatory anastomotic sites and produces a high local blood flow. Secondly, pain may abolish the response altogether and this is seen in subjects who are normally quite capable and predictable in the timing of their CIVD response. It is interesting to speculate how these facts fit in with the arterial cold paradox theory of Professor Knäuper (1978). The mechanism must in effect be broken, principle which he has related with delay or absent release.

Non-Fatal Injury

Prolonged cold exposure may of course induce continuing loss, but there are other unusual consequences. First, there seem cold exposure of the hands. I observed a person put disability leaving up to two weeks with severe stiffness and pain, gradually returning to normal. This followed an immersion in ice cold water of less than 30 minutes, and a further loss occurred in a second episode. I suspect these responses are sufficiently rare to preclude the need for extensive or permanent cold diaries, but it is a possibility.

PRESSOR AND VAGAL RESPONSES

The cold pressor reaction of increased dermal blood pressure, further increased systemic blood pressure and increased pulse pressure is familiar and has been described for centuries in literature (Sisson 1962). The response also occurs during hand cooling and sometimes proceeds to more serious general convulsions.

a. Fainting

Control subjects during the cold water dipper test often display this. If the test is conducted lying down it is a very gradual process with a slow development of loss of consciousness followed by slow consciousness.

b. The convulsed state

This is probably the same as (a) and is characterized by sudden pronounced fall of blood pressure. In the classical form the blood pressure reflex is supposed to occur by stimulation of left carotid sinus receptors due to continued stimulation of this chamber after all its blood has been expelled. The reflex attempts to a massive vasodilatation in the distal vessels which accounts for the fall in peripheral blood volume usually due to a fall in circulating blood volume. But none of this would seem to apply in the case of cold exposure, especially since we have been shown by Professor Kessinger (see p. 134) that temperature increases markedly up to the time of collapse. There is some fairly suggestive work on rats which shows exactly under general anesthetic conditions on electrical stimulation of the limbic area. Thus it is possible that a major pathway exists for sustained stimuli to inhibit the reaction, but in the human system almost any disturbance seems possible.

Blood Protection

The opportunity may be taken in this place to the difficulty of protecting the hands from cold. If cold with the pres-

sed vasodilatation, dilates all the vessels, backed up by the venous current that exchange layers of the skin circulation is of limited value. More important vasodilation is a means of confining the vasodilation and reducing the cold in an otherwise non-warmer area. Thick gloves produce precisely the same effect by more rapid heat loss, by relatively heated gloves provides the only effective compression.

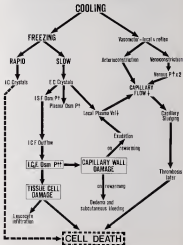
General body heating, especially from current, causes a powerful process in the skin against hand cooling. Instead it is of interest that cold experienced people use their hands as effective heat regulators even in the coldest environments and the higher the rate of work, the higher the gloves are pushed up the arm.

PROGNOSIS

Frostbite is a serious condition, but it is well to remember that its appearance often is apparent as an emergency. With our intensive treatment the results will almost always be better than would be expected in the first few days after injury. There is always considerable loss of tissue energy.

The pathogenesis of frostbite is complex, because there are various pathways by which cold injury can lead to cell death and not all may have been pointed in a particular case. An outline of the pathogenesis is shown in Fig. 1. On the left the consequences of rapid freezing are more cellular adaptations with disruption of the cell and cell death. There is probably less concern that the middle pathway is the figure in which slower freezing produces intracellular crystals which effectively remove water from the intracellular fluid. The local plasma volume falls, plasma osmotic pressure increases and therefore external fluid osmotic pressure increases. Intracellular fluid moves out in consequence and the intracellular fluid remains pressure even sharply leading to tissue cell damage and subsequently to necrosis or

PATHOGENESIS OF FROSTBITE



arterial occlusion occlude and when tissue haemorrhage is occurring. A third pathway leading to cell death is via a fall in capillary flow and sludging of the cells for thrombi of the blood within the capillaries. This is sufficient to prevent blood flow and later leads to thrombosis. Capillary sludging is particularly amenable to treatment by rapid rewarming.

Histologically the main changes seen in killed muscle are cellular damage and swelling, particularly cellular oedema and shaly rag.

Treatment

The most important factor governing the final outcome is the length of time during which the tissue was frozen. There is now ample evidence from many parts of the world that the immediate treatment of choice is rapid rewarming. Following this the conservative hospital treatment administered there can be initiated at leisure. Only one circumstance contraindicates rapid rewarming, and that is when the man would become so warm this possibly as a result of it. A man with a frostbite told me one night he would never be able to alter rewarming.

The findings here have shown in aquatic immersion in water between 42°C and 48°C for two hours. Nothing further needs to be said, more water below 42°C achieves less tissue injury in the long term prognosis, and water above 45°C causes increasingly greater damage than the less hot water. However, I would like to refer briefly to some experiments (Molnar and Winkler 1964) to show how such a series range of temperatures may be considered in the field by survivors without any instrumentation. The temperature would be as good the discomfortably high temperatures and to play safe by using cool water. This would be well below 42°C and certainly very close to low would follow.

It was shown that if a man had sufficient information on the changing tem-

peratures in a hostile land at different hot water temperatures, he could regulate the temperature of that water with varying accuracy. Evidence was sought that this was a sufficiently universal phenomenon for different men to use the same information and achieve the same result. By a series of laboratory tests a whole range of subjective descriptions of sensation felt in a control bath at precise temperatures between 42° and 47°C was collected. For such temperatures there were reduced to a few key words, and then a different group of subjects was tested to see whether they could find a water bath at a selected temperature merely by repeating the key findings with these key words and the corresponding temperature. It was found to be successful and furthermore when the bath was labelled by 1, the test subjects tended to get the wrong result by 1° also. Finally a field evaluation was carried out during a survival course in Norway and in these circumstances men could come through the water from their houses in the open test site and immediately proceed to construct a water bath between 42° and 45°C using only their hand and a small card on which the temperature sensation scale was printed. Thus a man could give his frostbite victims the best possible first and secondary procedure that he had a means of finding water.

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COLD WATER IMMERSION

Sergeant Thomas Commander Frank Golder gave a brief talk on the current research into Immersion Hypothermia at the Air Medical School. He illustrated this with a short film showing a recent cold immersion experiment in water at 8°C and subsequent re-warming in a hot water bath at 41°C.

He explained that the long-term aim of this work was to find a practical means of preventing hypothermia casualties in the field and, in particular, those rescued by helicopter. Because the narrowed flying range of modern helicopters obliged our divers to be rescued many miles from a hot bath they may experience a dangerous 'after drop' in body temperature whilst in the cabin of the helicopter.

He showed some temperature graphs obtained on two cold immersion experiments in which the 'after drop' in body temperature on removal of the subject from the cold water was a typical feature in all cases. One such case is illustrated in Fig. 1. In most experiments to date the 'after drop' reached its lowest point some eight to 12

minutes after immersion in a hot water bath.

He concluded by emphasising that in order to give the best chance of survival every effort must be made to reduce the 'after drop' during the rescue phase.



Fig. 1. After drop in body temperature in 12 minutes.

ACCIDENTAL HYPOTHERMIA

By R. S. C. Galloway

Abstract

Some of the environmental factors which adversely affect body temperature regulation are briefly outlined.

A brief risk diagram and an both first aid and control treatment of accidental hypothermia is proposed.

1. The Problem (Environmental Factors) *a. The Land*

The danger to life in a cold wet environment is very great, death usually being a direct result of indirectly a consequence of lowering of the deep body temperature or hypothermia. Experts say it is much more difficult to survive in a cold/wet than in a cold/dry environment where the temperatures encountered are of much greater magnitude. The explanation for this appears to reside first in the moisture which decreases the insulation of clothing and increases heat loss from the skin.

The insulation of clothing including clothing is reduced 50 per cent by wetting alone (Fahlgren 1963). Add to this the discomfort due to an increase in strong wind, and the insulation provided by clothing will be very small somewhere in the order of 4.5 clo which is the insulation of an adult at lower wind velocities, for example 3 mph. The discomfort effect of the wind may best be seen in the Siple Index (1943) wind chill index, shown in Fig. 1.

In view of the recent concerns of the Siple Index it is only fair to quote Siple's (1949) own view of his index expressed in Newburgh. Even though

these values are not precisely applicable to the cooling rate of the body, they are of the approximate order of magnitude.

From the Siple Index a duty to warn that an individual without adequate insulation in a moderate temperature and with a moderately high wind speed will be required to make major compensatory physiological adjustments in order to survive.

b. In Water

A more serious threat to life from hypothermia is present when the body is immersed in water at 20°C or less (Molnar 1944). The rate of loss of body heat in water is approximately 25 times that in air because of the difference in specific heat of water and air and the thermal conductivity of water (Bartman 1943; Fig. 2 showing the Barcroft (1942) adaptation of the Molnar Graph (1944) gives some indication of survival time, expressed for a normally clothed (i.e. dry) 55 kilogram man immersed in water.

This graph should not be interpreted too literally and should only be used as an approximate guide.



Fig. 1. Graph of wind chill index (loss of heat at various wind speeds) shown in Newburgh (1943).



Fig. 2. Deep versus rectal temperature for a 70 kg male (solid curve) and a 70 kg female (dashed curve). (From [10], p. 100.)

The many factors which influence rectal temperature in cold water have been more than adequately covered in this symposium by Professors Harvey and Hastings.

B. Awareness

As this symposium was entirely consistent with Cold War Survival, the type of hypothermia under discussion must be of the extremis variety and thus prolonged hypothermia can be defined as an unconscious lowering of the body temperature below 35°C in an otherwise healthy individual. The deep body temperature may be lowered by environmental conditions alone or in combination with some individual body characteristic. The rate of lowering of body temperature will depend largely on the environmental conditions. The time, quoted as the body of a lowering of temperature will ultimately be the cause of hypothermia progressing to death, varies somewhat because the rate of fall of body temperature is, in part, from the treatment aspect. The degree of disturbance in the patient is more likely to be encountered appears to be inversely proportional to the rate of fall in body temperature. For a simple guide to exposure assessment it is therefore helpful to classify accidental hypothermia according to the duration of exposure:



A. Acute Accidental Hypothermia

In acute accidental hypothermia the body loses heat extremely rapidly and suffers from profound hypothermia in six hours or less. It is caused characteristically by accidental immersion in cold water of 15°C or less.

The physiological disturbances seen in the patient are brought about almost instantaneously by a rapid fall in deep body temperature without any major stress passing disturbance in the water and climatic balance.

C. Complications

The condition may be complicated by partial drowning or if the water temperature was below 10°C by cold injuries of the extremities. In the severely ill, there may have been some inhibition of fuel oil or burn. Additional complications may arise during treatment, which will be discussed later.

B. Mild chronic accidental hypothermia

This type of accidental hypothermia has a moderately long duration of onset on hours plus. It is the type of hypothermia characterized characteristically as men and children and old women, as described by Hugh Critch. Usually in this condition not only has the body been struggling to maintain a normal body temperature in adverse environmental conditions for a period of hours, but also there is usually a considerable energy output involved in the manner being undertaken during this period. The temperature regulating mechanisms of the body are overloaded in order to fulfill the metabolic demands for energy. The high energy output gradually exhausts the body and plays a major contributory

rate in the cerebral collapse and deep coma hypothermia.

Into this category must also come the survivors, who were immersed in water of 15°C plus for more than six hours and are hypothermic on rescue. The intense shivering induced by these people over the period of immersion is likely to produce a state of exhaustion similar to that encountered in the fall victim, while the duration of most previous time for compensatory adjustment to be made in the water interval.

Complications

There may have been contributory to the development of hypothermia such as head or spinal injury or some other form of immobilizing injury. Complications come such as cold injury or frostbite may develop concurrently with hypothermia or this may in suboptimal waters and as in the water form additional complications may develop during treatment. These will be discussed later.

C. Chronic Alcoholoid Hypothermia

Chronic accidental hypothermia may take 24 hours or more to develop. It is the type classically seen in prison prisoners.

In this type of hypothermia as a consequence of the prolonged vascular collapse to cold, considerable compensatory adjustments have taken place on the water and salt balance of the body. The problems associated with this form of hypothermia are outside the scope of this symposium and the reader is referred elsewhere (Kendall Smith 1968; Duggall, Baggott and Rowers, 1969; Mackenzie, Channing, Cooper and MacLean 1967; McPherson and Smith 1968; British Medical Association 1968; Royal College of Physicians 1966; Mackenzie 1969).

3. Diagnosis

The diagnosis of hypothermia is easy if

suggested. The problem arises when there is some ambiguity in the data, or rather logical confusion which obscures the clear line of the diagnosing doctor.

The cardinal sign is evidence of the skin. This should immediately make one suspect concomitant hypothermia. Frequently hypothermia is suspected but dismissed when the oral temperature is recorded as being 35°C or higher if the thermometer has not been adequately checked using a conventional clinical thermometer which has 35°C as its lowest calibration. Accurate temperature recordings are not absolutely necessary for the diagnosis of hypothermia but if temperatures are being recorded a special low reading (34° to 40°C) thermometer should be used preferably at the high reading. As the thermometer does not record pH or electrolyte imbalance good clinical judgment is more important than arbitrary temperature or readings, especially in the management of the hypothermic patient. An oral or axillary judgement a lot of clinical signs and symptoms encountered in various body temperatures is shown in Fig 1.

4. Treatment

The first treatment of hypothermia is adequately prevention. The responsibility for a symposium such as this indicates how over the decades all the available knowledge on prevention, treatment of accidental hypothermia will evolve. Accordingly some advice on optimum methods of treatment is summarized below.

At the onset it must be emphasized that every effort must be made to treat hypothermic victims so that there have happened the conditions appear. This should be done even with people apparently dead from hypothermia as full recovery has been reported even after one hour in profound hypothermia with complete cardiac arrest (Moss and Lewis, 1967). The definition of death in hypothermia is false to all men. A speedy decision should be made

SYMPTOMS AND SIGNS IN ACUTE HYPOTHERMIA

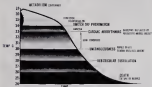


Fig. 1

is the method of treatment to be adopted and this must be rigidly adhered to. There is no time for cautious indecision.

The problem confronting every doctor in treating such cases is whether to replace the lost body heat rapidly or slowly and what if any supportive therapy should be given.

Basically the answer depends on whether one is dealing with a straightforward thermal problem, perhaps with minor variations in the pH and water/electrolyte balance, or with a thermal problem complicated by a major disturbance in pH and water/electrolyte content of the body. In the former a speedy reversal of the thermal problem is all that is required, leaving the body to readjust the remaining major physiological imbalances itself. In the latter, with a speedy reversal of temperature involving a rapid return of cellular metabolism

demands could not be tolerated by the body and would in all probability prove rapidly fatal.

Therefore in summary:



A. ACUTE ACCIDENTAL HYPOTHERMIA.

(a) First Aid Treatment

Remove the victim from the hypothermia-producing environment. Re-establish circulating of the victim in a minimum 60-90°C. manage or reb-approximately 15 minutes 20 or 30 minutes of a hospital or urgent medical care

lightly cover the victim with blankets, his personal and further heat loss, or preferably enclose him in a polythene bag and transfer him immediately to a warm medical unit. If oxygen is available administer it.

It not within 30 or 60 minutes of exposure and then positive attempts at resuscitation must be made immediately as outlined below under cardiac arrest.

Complications which may possibly develop during WMA and immersion or hypothermia are:

a Hypertension. A shock like state may develop as the peripheral vasoconstrictors and the existing mild vasoconstriction is elevated the bleeding into the peripheral tissue will then produce severe hypertension. It is, therefore, advisable to transport the patient to a slightly head down unit (ank). Avoid giving an excess of fluid (but not too much), and definitely NO ALCOHOL.

b Unconsciousness. This may be present on arrival, or should the casualty be some some time on ice, or may develop 10 to 15 minutes later. In this instance the continued fall in deep body temperature after arrival, that is called that drop may well lower the temperature sufficiently to cause unconsciousness. The hypothermia sustained above may in itself produce unconsciousness.

Whatever the cause of unconsciousness, the usual procedures of maintenance of a clear airway should be strictly followed.

c Cardiac Arrest. Cardiac arrest due to either asystole or ventricular fibrillation is the terminal event in hypothermia. Resuscitation may sometimes arise when the resuscitative efforts

of the resuscitator trigger fibrillation in the cold stunned myocardium, or it may develop slowly after resuscitation when the returning chilled blood from the resuscitating peripheral circulation returns to the heart.

Should a severe, sustained cardiac arrest should be commenced or maintained, preferably at a slower rate than one would use in a normothermic patient.

But a word of caution is necessary about a heavy diagnosis of cardiac arrest in prolonged hypothermia when marked peripheral vasoconstriction exists. Bradyarrhythmia and dilated pupils are a feature of the profound changes at cardiac arrest at this stage will undoubtedly precipitate immediate fibrillation.

d Respiratory Arrest. The obvious respiratory depression always found in deep hypothermia makes it difficult to tell sometimes whether respiratory arrest has occurred. Should it follow cardiac arrest, it should be treated by assisted air resuscitation. This should not be carried out too vigorously as it may produce hypoxemia which would be detrimental to the body at this time (Kritzege 1966).

the Cause Treatment

In mild, accidental hypothermia the body temperature has been lowered typically 1-2°C below 37°C. The body makes major vascular adjustments, in an effort to conserve body heat, but there is insufficient time to make major alterations in its electrolyte composition. Therefore one is dealing predominantly with a thermal problem complicated by minor alterations in acid/base and water/electrolyte balance. The treatment of choice therefore is a rapid reversal of the hypothermia state (Kritzege 1966). Many

and Lewis 1959; Betts and Wigles 1960; Kenington 1969). This is best achieved by immersing the body in a bath of water heated to 40-41°C if naked or at 44-45°C when clothed. Alternatively to keep the water stirred and adding hot water intermittently to maintain a reasonably constant bath temperature. The monitoring required in warming the patient who will have considerable muscle rigidity, may be as great as to preclude ventricular fibrillation. Accordingly if clothed an extra blanket laid at the back with his clothes on and run down off in the bath when necessary is well established. If possible only the trunk should be immersed keeping the limbs out of the bath (Ramsay 1966). Oxygen should be given by an attached mask if available (60 per cent O_2 + 5 per cent CO_2). Leave the patient in the bath until he says he feels warm, then remove him and place him in a warmed bed.

In general apart from the above active measures required for resuscitation should they arise, all forms of monitoring should be avoided. Administration of the urine and creatinine clearance fluid will return to normal of their own accord when normal cell temperature is restored.

Complications which may develop during treatment

a. Hypotension. Sudden collapse during warming may be due to hypotension. To reverse the patient from the bath and tilt the head down until consciousness returns, then replace the patient in the hot bath keeping the limbs elevated in warm covers however. 500 ml of warmed Plasma IV should prove helpful, particularly if the patient has been treated from the sea where he may well have lost

blood volume. An attempt to lie down with serious risk, but to attempt.

b. After drop in body temperature. During warming after rapid or slow there will be a further fall in deep body temperature demonstrated in Fig. 13, page 169. This can be as much as 3°C (Alexander 1949) and can therefore prove a major problem during resuscitation. Both Lewis (Alexander 1949; Betts and Wigles 1960) and Ramsay (Ramsay 1966) commenters have shown that the survival duration was greater with rapid than slow warming in some accidental hypothermia.

c. Cardiac arrest. Ventricular fibrillation is likely to occur at myocardial temperatures below 33°C (Ramsay 1967; Cooper and Rens 1966). This is especially likely during the warming phase (Harley, Woulfe and Hagdon 1957) when the chilled cardiac blood from the peripheral circulation returns to the core circulation in large amounts. Added to this the blood is partially hypoxic and hypoglycaemic at this stage because of the demands of the warming process for both oxygen and sugar. Pender *et al* (1957) quote as example of a 29 year old woman who had undergone anaesthesia following a period of hypothermia a few weeks previous surgery who developed ventricular fibrillation at a deep body temperature of 30.4°C. Anti-arrhythmic drugs should not be given prophylactically as they can produce cardiac arrest or pre-terminate fibrillation in hypothermia (Drugs and Therapeutics Committee 1971). Atrial fibrillation is common in hypothermia and does not require any specific treatment.

Should cardiac arrest develop during the warming phase cardiac mas-

age must be reversed immediately and maintained until such time as DC defibrillation can restore sinus rhythm. Early (1954) has shown that in cases of ventricular fibrillation after cardiopulmonary bypass surgery magnesium sulfate 50 g/kg body weight administered IV during the resuscitation phase rapidly facilitates the restoration of sinus rhythm as the body temperature reaches 36°C. This occurred spontaneously in 46 per cent of cases while in the remaining 11 per cent only one single application of the defibrillator was required to restore sinus rhythm. Linton and Ledingham (1966) say that defibrillation is likely to be successful only when the myocardial temperature is at least 35°C. Before this temperature the adverse effect of temperature on oxygenation of the myocardium and the interference with coagulation make defibrillation unlikely to succeed. Similarly in severe cardiac defibrillation is unlikely to succeed. The only way should therefore be treated with NaHCO₃, probably warmed before introduction. In early profound hypothermia including those apparently dead external cardiac massage and intubation with positive pressure respiration is always worth trying. Under these circumstances period of warming of the torso with hot water (34°C) should be considered as an effort to speed up the rate of rise of myocardial temperature.

d. Arterial Hypotension. As has been found in ACU's marked respiratory depression occurs in hypothermia, but nevertheless sufficient ventilation is taking place to cope with the low metabolic demands of the body. There are also reflex responses as not as much an indication for treatment.

During resuscitation there will be

an increasing demand for O₂ is hoped that control of the respiratory center will keep pace with this increasing metabolic requirements in which case 95 per cent O₂ + 5 per cent CO₂ administered by one nasal mask should satisfy the need.

Unnecessary increase of airway can postpone necessary ventilation by causing reflex bradycardia (Drug and Therapeutic Bulletin 1971). Artificial ventilation can also cause ventricular fibrillation by producing an abrupt fall in the arterial pO₂ (Shaw and Miller 1962). Should artificial ventilation be necessary care should be maintained not to over ventilate during the initial stages of resuscitation as the hypoxia produced would have the most disastrous consequences on both the oxygen dissociation from the blood and the cerebral blood flow. However if the patient has been partially drowned then intermittent positive pressure ventilation (IPPV) will aid the expansion of partially collapsed and oedematous alveoli. If IPPV is being used it should be used in conjunction with a heated humidifier (Ledingham and Moss 1971).

e. Arterial Thawing. Should an increase change be necessary all in conscious fluid must be maintained at 35°C before transfusion (Fryman and Fugh 1969) to prevent a further and possibly disastrous fall in core temperature.

E. SUB-AQUA ACCIDENTAL HYPOTHERMIA

In sub-aqua hypothermia the onset of hypothermia is a relatively slow process accompanied by increased muscular tension in the form of shivering or actual rigors or both. The lowered body temperature inhibits the metabolic breakdown of glucose. The resultant buildup of lactic

and the body's ability to deal with this because at lower temperatures, with the production of a metabolic cooling, several internally acting compensatory physiological adjustments are taking place in an effort to conserve heat.

There is a peripheral vasoconstriction with a resultant increase in central volume pressure, causing a suppression in the production of ADH and therefore a cold diuresis while at the same time there is a shift of fluid from the vascular to the interstitial spaces. The net result is a reduced blood volume, haemoconcentration and an increasing blood viscosity. Added to this there is a fall in the body's glycogen stores and a fall in the blood pH (Fryd 1960). The net overall result is a considerable disturbance of the entire organism. However, the evidence (Fryd 1960) is that unconscious or nearly unconscious patients rarely spontaneously come further cooling has been prevented.

(c) *First Aid Treatment*

On the battlefield, first aid and first-aid men is to remove the victim from the hypothermia, producing unconsciousness. In this instance, any shelter, remove all wet clothing, including underwear, and replace with dry clothing, if necessary have others use, without some sort of clothing if no spare clothing is available. If possible place the victim in a sleeping bag. Or, close the sleeping bag in a large polythene bag and seal it from the ground by making a mattress of a thick layer of blankets or foam. If conditions give the victim some hot sweet drinks, NENDR give alcohol.

A decision must then be taken whether to double the party and wait for help or to place some strategic distance/location between and treat alone. This decision will have to be made by the party leader and will depend to a large extent on such

factors as party size, individual fitness, state of day weather conditions and local rescue facilities.

Complications which may develop during treatment in transportation are:

a. *Hyperventilation*. This occurs for some but reasons to those observed in some accidental hypothermia. However, the long, cold interval normally encountered becomes dangerous and requires treatment with interesting difficult transportation problems, combined with the rapid haemoconcentrations make this a potentially serious hazard in sub-zero hypothermia.

The development of hyperventilation, probably as it does a reduction in coronary perfusion, may be the key, going later in producing ventricular fibrillation in many of these cases who are rescued alive but die during transport down the mountain.

Rapidly diagnosed hypothermia it is advisable to lay the patient with his head down the neck of the bag or transport him in the head down position. He should never be allowed to walk even if he starts to feel recovered, definitely to die so.

Caution should be exercised in assuming that the rescuer knows where, when do not become exhausted and thus liable victims of hypothermia.

b. *Haemoconcentration* or *in ADH*

It should be remembered that an initial blood supply may have played a significant role in the production of hypothermia in the patient under care and therefore a detailed neurological examination must be carried out to rule out possible structural trauma or all mechanical, toxicological and infectious processes.

c. *Cerebral Arrest* or *in Adrenal*

d. *Respiratory Arrest* or *in Adrenal*

c. **Hypothermia.** Is particularly likely to occur as the metabolic demands of the body increase, therefore administer oxygen if it is available.

iii) Cardiac Treatment

A rapid reversal of the lowered body temperature of sub acute accidental hypothermia would usually restore the ability of the body to adapt to hypoxia and perhaps the vital body tissues, as well as warming the already described water and electrolyte balance. Therefore the treatment of choice must remain close warming at normal temperature with full supportive therapy as indicated.

Perhaps it is worth making a word of caution at this stage about a too liberal interpretation of serum electrolyte measurements while with a major disturbance of the distribution of body fluids exists. Likewise it is undesirable to base any corrective action on results obtained from aspirated and peripheral venous blood. Ideally an arterial catheter should be used for blood sampling and pressure monitoring. It is generally unnecessary and unwise to try and correct biochemical disturbances in hypothermia until warming is well established (Larson 1977).

Nearly five per cent Oxygen + 5 per cent CO₂ should be given to all cases. If indicated, IPPV should be used, not only as a means of counteracting the hypoxia but also as a reversing collapsed and occlusive airways more rapidly than would occur spontaneously. IPPV is also an efficient capital means (quite when used in conjunction with a heated humidor) (Lofgren and Moore 1975).

Although there is no evidence to prove that there do have any dramatic effect in profound hypothermia they cannot be profitably withheld. On the

point it is worth noting that the low, a rectal temperature, even recorded in a subsequent survival of cerebral hypothermia, was in a young subject in Chicago who was admitted to hospital with a rectal temperature of 14°C (Lofgren 1971). The temperature increased rapidly to 20°C following an intravenous (Ringer's Lactate) infusion at 500ml of 4°C saline. In view of the poor degree of absorption likely in such circumstances the exact significance of this sudden rise in temperature cannot be definitely assessed. It could have been purely coincidental. In sub acute hypothermia arterial extension from prolonged arrest is likely and therefore there probably is a place for steroids in its treatment (Dugan *et al* 1981).

Complications likely to be present during or arising from treatment

a. Cardiac Arrest (Lofgren and Miller's Analysis)

The metabolic causes usually manifest as ventricular premature (Parley *et al* 1977). This should be treated with NaHCO₃ 4.5 per cent warmed to 38°C before administration, as well as IV therapy.

c. **Hypohydration.** This should be treated with 5 per cent glucose saline.

d. **Woundburns** may also develop during rewarming but which rarely take action may be necessary.

e. **Discontinuing** some gross electrolyte and/or acid phenomena may complicate sub acute accidental hypothermia although both are more usually terminated in the chronic state (Marr 1969).

f. A possible late complication of sub acute hypothermia is acute nephrosis (Lofgren 1971; McKays, Simon, Geyser and Irvine 1970).

Finally it cannot be over-emphasized that the tolerance of death in hypothermia is related to survival.

5. Conclusion

(a) Immersion in cold water produces rapid falls in deep body temperature accompanied by many alterations in blood pH and electrolytes. The time taken consists of rapid reversal of the body temperature by immersion in a hot bath at 41°C.

Obviously speaking it is unnecessary and useless to try and correct the biochemical disturbances. If necessary then it should not be undertaken until the resuscitation is well established.

(b) An ideal hypothermia produced in animals which involves high metabolic energy expenditure over a period of time is usually accompanied by moderate to severe biochemical changes, which may require correction but again only when resuscitation is well established in the animal remaining should be done.

(c) Attempts at resuscitation must be made even in those apparently dead.

Acknowledgment

The assistance of Sergeant Commander J. Rogers, R.N. for his helpful suggestions in writing this paper is gratefully acknowledged.

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The Symposium was followed by a most interesting discussion. Unfortunately, for reasons of space it has not been possible to include minutes in this issue, but it is hoped that an account may appear next year.

(Edwards)

HISTORY OF THE ROYAL NAVAL HOSPITAL, PLYMOUTH

Part II A Walk Around the Hospital

By P. D. Gordon Pegib

Now, approaching a corner and a half, since the corner of Governor Corbett and having established in our mind's eye some idea of the nature of things at the Naval Hospital in her day let us take a walk around the Hospital and discover what changes have taken place over the years.

While both Plymouth Hospital like Harker and Greenough, was so used that there were crutches to bring their beds from their steps to the hospital, without having recourse to land carriage. Hence the North Gate, facing on Northampton Creek, was of more or less equal importance to the South Gate which led to Clarence Place. Nowadays, access to the hospital can only be gained through the South Gate, hereafter called the Main Gate, and it is there that we must begin our tour.

The Main Gates

We are immediately struck by the splendour of these gates which bear the Royal Arms and crests of Queen Victoria (Fig. 13). In 1902 the Main Gate of the Hospital was rearranged and advanced into line with Clarence Place on a small piece of land purchased from the Earl of Mount Edgmont. A road was constructed to the right of the entrance thus giving access to the hospital without approaching the Square. The Main Gates were formerly situated between two walls, the 18th century buildings that housed the Officers of the Subalterns' Guard. Both these houses are ruins, one is occupied by the Hospital Provost and the other by the Hospital Foreman.

About 1902 two brick residences were erected for the Superintending Physician and the Senior Wardmaster Officer. These initially withstood the Main Gates, were enclosed by them in the rearrangement of 1911. Both houses were completely destroyed in 1942 by enemy bombing and their site is now occupied by the car park near the Hospital.

Outside the site of the older gates, but within the present Main Gate, the original Grand Entrance still stands — used recently and as the Receiving Room. A new room takes the office of the Adjutant-General (Medical) and the Wardmaster's Office. In former times, and indeed up to at least 1850, a Subalterns' Guard of Royal Marines was posted in the



Fig. 13. Main Gate of the Royal Naval Hospital, Plymouth.

Notes: 1. The gate was built in 1850 by the Earl of Mount Edgmont. 2. The gate was destroyed by enemy bombing in 1942. 3. The gate was rebuilt in 1945. 4. The gate is now used as a car park.



Fig. 10. The Naval School, Annapolis, Maryland, 1911

Now, the Naval School, Annapolis, Maryland, is a large, multi-story building, with a prominent chimney, and a flag flying from a pole in front. The building is a large, multi-story building, with a prominent chimney, and a flag flying from a pole in front.

was nothing but a huge mud flat. As high tide it was an attractive sight with reeds and other wild life.

The use of the old pits ceased shortly after World War I. With the advent of motor transport patients were now conveyed by ambulance to the Main Clinic. In former times the rooms near the North Gate were used for hot and cold baths. The old Recovery Rooms and the page store were situated near the place that also were the bath rooms, the bath master's quarters, and a room for bath chairs. The bathing slip was over 36 meters long, and the pits 13 meters long, with two flights of bathing steps and a level paved area. The Admiral's Bathhouse, two rows wide here. Today the whole area presents a very spectacle. Bathhouse Creek, now is the cause of being filled and reduced by the Living Authority for development as playing fields is a glorified rubbish tip. The Admiral's Bathhouse has gone, but the pits remain and the slip can just be designated. Most of the garbage was

sent to a rubbish tip in front. I repeat the original bathhouse was now replaced in the office by the new galleys dismantled from the Main Inner Gate during World War II.

The Square

Let us now create our steps back to the Square. The original buildings on the west side still remain but also, the chimney and brick frontage is no longer with us (Fig. 16). By 1921 the old brick was already up standing in such an extent that it was found necessary to remove the front of the building. This brick contains four row dormers occupied by the Consul and the Consul's Nearest Neighbors, the Consul and the Consul's Nearest Neighbors, the Consul and the Consul's Nearest Neighbors. The garden behind remains, but the stable, built between garages. Behind them a small range of three houses, formerly the quarters of assistant surgeons and cooks is now occupied by post-graduate Surgeon's assistants.

The remaining houses on the Square all created about 1880. They have a very similar appearance to when first built. Their stone facades are more important. The Surgeon's Bathhouse (Fig. 17) on the north side of the Square, first occupied



Fig. 11. The Naval School, Annapolis, Maryland, 1911

Now, the Naval School, Annapolis, Maryland, is a large, multi-story building, with a prominent chimney, and a flag flying from a pole in front. The building is a large, multi-story building, with a prominent chimney, and a flag flying from a pole in front.



Fig. 1. The former Main Gate of the Naval Hospital, built in 1895. The main gate was apparently rendered dangerous by bombing more than once in World War II and eventually used to replace the missing North Gate. The main railings were removed for the most effect, and the overhead overhead lamp disappeared to make room for the latter vehicles that enter the Hospital at these days (Fig. 9).

In Captain Taylor's house, I clearly impression by itself with two rooms on floors and a placid under the ground feature of which is an ancient wellberry tree. At some time in the last century past the western third of the western wing got off to make a residence for the Staff Surgeon. Today it is occupied by the Commandant in Chief, perhaps. To the west of the Admiral's Residence the staff room Chaplain's Room, which in the same period appears rather inconspicuous. Today, the Chaplain's Room is the Medical Store, and the home is occupied by Nursing Sisters. The first building on the south side of the Hospital is also quite changed by former times it was the Surgeon, Main and the Residence of the Staff Surgeon. Damaged in World War II, it was extensively renovated in 1945 and is now the Medical Officers' Mess (Fig. 10).

The former Main Gate

If we turn back slightly an upper view down one of the houses, on the west side of the Hospital, we may look along the main axis of the Hospital. There are a number of 19th century impressions of this view, and

the striking thing is how little it has changed during the last 100 years (Fig. 11, 19). The former Main Gate of course belongs to the beginning of the 19th century. Sadly, only the gate piers remain. Looking very looking they are flanked by low stone walls and the part of single 19th century pavilions. The main gates apparently rendered dangerous by bombing more than once in World War II and eventually used to replace the missing North Gate. The main railings were removed for the most effect, and the overhead overhead lamp disappeared to make room for the latter vehicles that enter the Hospital at these days (Fig. 9).

The Original Posting Box

The problem on the left is now, for Pay Office and was formerly the Surgeon's Office and originally the Agent's Office and former Lodge. Guided an unusual original posting box is still in existence (Fig. 12). This box, which is light and heavy, the form of collection gained on an side by was used before the introduction of separate notice plates has been in the hospital for very many years, its structure being altered by naval personnel and later along to the nearest post office for posting. Its design is very similar to the early mounted notice boxes provided for the Post Office by John W. H. of Gloucester and Andrew Hardy of Derby in around 1835 (Parsons, 1949). Like Hardy's earliest boxes, it does not bear the word 'office' nor the famous 'Post Office' and 'Letter Box' nor does it bear any maker's name. It has a flat instead of a peaked top and an external instead of the usual internal hanging flap over the post aperture. While its origin remains uncertain it seems likely that it was made by one of the early Post Office contractors of around 1835, from an official pattern specially for use at the Royal Naval Hospital.



Fig. 16. View of the Royal Naval Hospital, Portsmouth, 1882.
 The building is the same as the one shown in Fig. 15, but the
 tower has been added to the main building.



Fig. 17. View of the Royal Naval Hospital, Portsmouth.
 The building is the same as the one shown in Fig. 16, but the
 tower has been added to the main building. The view is from
 the water, looking across the lawn towards the building.



Fig. 10. The Pillar of Pope Sixtus, 1570, set up by the Pope in 1570.

When 1570, it was set up by the Pope in 1570, and it was set up by the Pope in 1570, and it was set up by the Pope in 1570.

The Surgeon-Rear-Admiral's Office

The porch on the right contains the Surgeon-Rear-Admiral's Office. It was set up by the Surgeon-Rear-Admiral's Office. It was set up by the Surgeon-Rear-Admiral's Office. It was set up by the Surgeon-Rear-Admiral's Office.

1745 and Surgeon-Rear-Admiral's Office. It was set up by the Surgeon-Rear-Admiral's Office. It was set up by the Surgeon-Rear-Admiral's Office. It was set up by the Surgeon-Rear-Admiral's Office.

In the Surgeon-Rear-Admiral's Office is a board on which is inscribed the names of the previous Admirals of the Fleet, from Captain Cooke to the present time (Table 1). There is also a Royal Arms of polychrome painted on wood the top of which is a coat of arms of June 1, 1570, and apparently remained unchanged until the Accession of Queen Victoria (Fig. 21). It would seem therefore that the Arms may be those of either George III, George IV or William IV (Tupper, 1908). The small shield in the centre with the Crown above it is for the Kingdom of Hanover, and the three crowns of it are said to be for Brandenburg, Saxony, and Silesia, the names with the white horse being for the last. The white horse is of course commonly called the white horse of Hanover. The very small shield in the centre of the wall, shield is charged with the Crown of Chertsey, and signifies the High Treasurership of the Holy Roman



Fig. 21. The small shield in the centre of the wall, shield is charged with the Crown of Chertsey, and signifies the High Treasurership of the Holy Roman

TABLE I

THE MEMORIALS OF THE DOCK
IN THE LONDON DOCK HISTORY OF
THE DOCK

1700-1701	
Captain Richard Caple, Wm. M.	1700
Captain Wm. M. Caple, R.N.	1701
Captain Caple, Wm. M.	1702
Captain Caple, Wm. M.	1703
Captain Caple, Wm. M.	1704
Captain Caple, Wm. M.	1705
Captain Caple, Wm. M.	1706
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Captain Caple, Wm. M.	1798
Captain Caple, Wm. M.	1799
Captain Caple, Wm. M.	1800



The coat of arms of the Royal Naval Hospital, as it appeared in the 18th century. The shield is supported by two lions, and the crown above it is surmounted by a cross. The motto scroll below the shield reads: 'HOSPITALIS EST MORS'.

English. On the death of William IV the Kingdom of Hanover separated from the British Crown and the Hanoverian Arms were in consequence retained after the restoration of Queen Victoria.

The greatest treasure in the office is, however, the large portrait in oils of Governor Richard Caple, which has recently been cleaned most successfully (Fig. 4).

The Hospital

Looking beyond the Main Inner Gate, along the main road, one goes straight on to the open hospital, and then through the open west side of the quadrangle, one enters the main entrance, where the main hospital was built (Fig. 25). We notice the old model in the centre of the quadrangle and our gaze terminates on Trenchard Block with its clock tower, which forms the east end of the main wing.

The model appears to nearly all the 18th century appearance of the hospital and has obviously been a focal point ever since (Figs. 24, 25). The old is described

ROYAL HOSPITAL, HAMPSTEAD

1. GENESEY LONDON

Lot 20-25

John Collier, 100, Newmarket Street, 1787
84 & 85, Piccadilly, 1788-1789



Fig. 3. General View of the Royal Naval Hospital, Portsmouth, 1906.

The building is a large, ornate structure with a central dome and multiple windows. It is situated in an open area with other structures visible in the background.

Fig. 4. View of the Royal Naval Hospital, Portsmouth, 1906.

The building is a large, ornate structure with a central dome and multiple windows. It is situated in an open area with other structures visible in the background.





Fig. 15. The binding of the 'Quadrant' codes.

Fig. 16. The binding of the 'Quadrant' codes. The binding is made of wood and is very old.

He is regarded as the likely maker of the dial. However, it could have been made by his father, John Collier, who also flourished from 1730-65. His trade card read thus: *Maths. and Astro. Instruments and Great All Sorts of Mathematical Optical and Philosophical Instruments.*

The pedestal, unfortunately damaged in World War II, stands on a circular base comprising six stones, three raised in each corner. This base has been identified by the Law of the Museum, London, as undoubtedly a masterpiece of the type known as a French base. There are not many, but they are usually built up from 12 pieces arranged in two rings of six, and are decorated together in the 16th-18th c.

Trinity Block and the Hospital Library
Trinity Block and the Hospital Library

There are 16 original, and three storage, books. These with parts of each former and outside the quadrangle, north corner, at the middle of the north and south sides. Four copies, every previous copy, are made by two of the wood blocks on the north and south sides (Figs 18, 19).

Trinity Block (Fig. 20) which runs east to and the Chapel, the Dispensary, and the Dispensary's Quarters, runs east from north to the Aisle Room and an adjacent Ward is now the Central Administrative Block. It contains the offices of the Principal, Matron, and the Principal Admin. Officer. It also houses the Pathological Laboratory.

It was Thomas Turner, who first suggested that a Central Medical Library should be founded in 1860. Thirty years were to elapse between the publication of



Fig. 10. Plan of the River Mersey and its immediate vicinity. 1:250

Note. This plan was taken from a sketch drawn by Mr. F. C. Burt from a sketch by Mr. J. H. Burt and Mr. J. H. Burt, and published by E. Burt and continued by Mr. J. H. Burt. It is based on the 1870 Ordnance Survey map of the River Mersey and its immediate vicinity. It was a very old map.



Fig. 1. Plymouth Hospital, Plymouth, Devon, South West England (Henderson).

Fig. 2. The Plymouth Library, Plymouth, Devon, South West England (Henderson).

Townsend (1790) and their acceptance of privilege. I saw Mr William Harvey when he returned that the hospital at Plymouth and Haver was equipped with libraries. The Plymouth Library (Fig. 2) is by no means as large as that at Haver, but it is still the best in important way. Amongst its treasures are the manuscript journals of Captain Richard Ogden and the Hospital Library Book, 1567–1774. The latter is concerned with administrative details like the repair of the main engine, the state of the fire engines, and checks about the 'incoming harvest' and on effect on the contract for the supply of bread. Many of the works in the library are over 150 years old and some date back to the early 16th century.

The Library has experienced many vicis-



Fig. 3. Plymouth Hospital, Plymouth, Devon, South West England (Henderson).

Fig. 4. The Plymouth Hospital, Plymouth, Devon, South West England (Henderson).

situdes. During World War II it was housed in a Pavilion. There it had a skin museum, a book end, a medical all the more extensive a bookplate system was added in Volume 36 of the *Edinburgh Medical Journal* for 1951. The Library was reorganised, reequipped and rehoused in its present site in Trafalgar Block in 1962 (Lowe, 1981). Since that time every effort has been made to build it up with modern books of which there is now a very comprehensive selection.

Opposite the Library is the Conference Room and here there is a part of the original display cabinet containing some examples of several medical instruments, including three syringes. Beside it is placed pharmacy jars dating to the inception of the hospital in 1516 (Page, 1933).

The canopy of Trafalgar Block projects boldly with a pediment containing a lunette. Above it is a tower with a cupola (Fig. 2). The face clock, installed in 1976 by Gough & Son of Russell Street, Covent Garden still keeps remarkably good time. The large bronze bell was taken down for safety during World War II and is now to be put on display in the gardens. The last state of the building is distinguished



Fig. 19. Front elevation of Central Block, Royal Naval Hospital Plymouth.

Note: The two clock towers built in 1778 (1. Clocktower at base of Chapel. On the left of figure is a clocktower, 2. at right. This is the original clock tower. Both of them are kept. Tower built last clock tower for 1878.

by the use of types of Norman window. On the west wall too, may be seen a plaque unveiled by Lord Carrington First Lord of the Admiralty, on June 29 1942 to mark the centenary of the foundation of the Hospital.

The Wards

The general wards of the Hospital were contained in the 10 three-storey blocks surrounding the central tower. They were originally identified by numbers. The wards, one in each block, were also numbered up to 50.

Between 1880-85 the ward blocks were reconstructed and steel escape stairs and sanitary systems added. The dividing wall between the two wards on each floor was taken down, each block then consisted of three large wards. The continuous granite Terrace colonnades which link the Blocks for three sides of the quadrangle were on sympathetically placed at about the same level and upper corridors built over them on the north and part of the south sides (Fig. 16).

Left tower with clock, built for all the Blocks were built 1862-63.

The numbering of the blocks and wards continued unchanged until 1924 when Garrison Rear Admiral A. Gifford the Medical Officer in Charge had the blocks renumbered from A-I and the wards numbered 1, 2 and 3 on each block. In addition each block was given a name on its portal. The central block was called Trajanter and the other blocks:

- A. Trajanter
- B. D'Almeida
- C. Agassiz
- D. La Plante
- E. Johnstone
- F. Nile
- G. St. Vincent
- H. Gibraltar
- I. George Bonny
- J. San Domingo

Apart from Trajanter, these names have largely fallen into disuse and today we refer to A1, A2, A3 etc.

In the bombing of 1941-42, E Block, formerly J Block, was totally destroyed and I and J Blocks formerly 9 and 10 Blocks were severely damaged and have



Fig. 20. View of Central Block, Royal Naval Hospital Plymouth, looking north.

Note: The middle building is the plan of 1862-63, a 1911-12, 1913 and built by 1924-25. The middle building is the original, the plan of 1862-63, 1911-12, 1913 and built by 1924-25. The middle building is the original, the plan of 1862-63, 1911-12, 1913 and built by 1924-25.

remained unaltered, and blocks A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, CX, CY, CZ, DA, DB, DC, DD, DE, DF, DG, DH, DI, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DS, DT, DU, DV, DW, DX, DY, DZ, EA, EB, EC, ED, EE, EF, EG, EH, EI, EJ, EK, EL, EM, EN, EO, EP, EQ, ER, ES, ET, EU, EV, EW, EX, EY, EZ, FA, FB, FC, FD, FE, FF, FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FQ, FR, FS, FT, FU, FV, FW, FX, FY, FZ, GA, GB, GC, GD, GE, GF, GG, GH, GI, GJ, GK, GL, GM, GN, GO, GP, GQ, GR, GS, GT, GU, GV, GW, GX, GY, GZ, HA, HB, HC, HD, HE, HF, HG, HH, HI, HJ, HK, HL, HM, HN, HO, HP, HQ, HR, HS, HT, HU, HV, HW, HX, HY, HZ, IA, IB, IC, ID, IE, IF, IG, IH, II, IJ, IK, IL, IM, IN, IO, IP, IQ, IR, IS, IT, IU, IV, IW, IX, IY, IZ, JA, JB, JC, JD, JE, JF, JG, JH, JI, JJ, JK, JL, JM, JN, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX, JY, JZ, KA, KB, KC, KD, KE, KF, KG, KH, KI, KJ, KK, KL, KM, KN, KO, KP, KQ, KR, KS, KT, KU, KV, KW, KX, KY, KZ, LA, LB, LC, LD, LE, LF, LG, LH, LI, LJ, LK, LL, LM, LN, LO, LP, LQ, LR, LS, LT, LU, LV, LW, LX, LY, LZ, MA, MB, MC, MD, ME, MF, MG, MH, MI, MJ, MK, ML, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NB, NC, ND, NE, NF, NG, NH, NI, NJ, NK, NL, NM, NN, NO, NP, NQ, NR, NS, NT, NU, NV, NW, NX, NY, NZ, OA, OB, OC, OD, OE, OF, OG, OH, OI, OJ, OK, OL, OM, ON, OO, OP, OQ, OR, OS, OT, OU, OV, OW, OX, OY, OZ, PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM, QN, QO, QP, QQ, QR, QS, QT, QU, QV, QW, QX, QY, QZ, RA, RB, RC, RD, RE, RF, RG, RH, RI, RJ, RK, RL, RM, RN, RO, RP, RQ, RR, RS, RT, RU, RV, RW, RX, RY, RZ, SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR, SS, ST, SU, SV, SW, SX, SY, SZ, TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO, TP, TQ, TR, TS, TT, TU, TV, TW, TX, TY, TZ, UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ, UK, UL, UM, UN, UO, UP, UQ, UR, US, UT, UY, UZ, VA, VB, VC, VD, VE, VF, VG, VH, VI, VJ, VK, VL, VM, VN, VO, VP, VQ, VR, VS, VT, VU, VV, VW, VX, VY, VZ, WA, WB, WC, WD, WE, WF, WG, WH, WI, WJ, WK, WL, WM, WN, WO, WP, WQ, WR, WS, WT, WU, WV, WW, WX, WY, WZ, XA, XB, XC, XD, XE, XF, XG, XH, XI, XJ, XK, XL, XM, XN, XO, XP, XQ, XR, XS, XT, XU, XV, XW, XX, XY, XZ, YA, YB, YC, YD, YE, YF, YG, YH, YI, YJ, YK, YL, YM, YN, YO, YP, YQ, YR, YS, YT, YU, YV, YW, YX, YY, YZ, ZA, ZB, ZC, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN, ZO, ZP, ZQ, ZR, ZS, ZT, ZU, ZV, ZW, ZX, ZY, ZZ.

The Pavilion

The four pavilions that comprise the Model Block, named A, B, C, A Pavilion

which is adjacent to A and B Blocks, was originally the Hospital's cinema house it was the Lyric Theatre, and later still the picture theatre. Built between 1954 to a new Operating Block (Figs 30-33) which also housed the Surgical Out Patient Clinic was constructed on this site. The stones of the original pavilion were incorporated into the walls of the lower story of the new block (Hillier *et al.* 1967).

B Pavilion which lies between C and D Blocks, was originally the Sunlight Ward and later the Operating Theatre and a ward. Today it is the NAAFI Canteen.

C Pavilion which lies between D and H Blocks, was originally the Kitchen and Dining Hall, in later years it accommodated the Senior Staff, Nurse Staff, and it is now occupied by the Department X-Ray De-



Fig. 1. The four pavilions of the Model Block, 1954-1955.

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, CX, CY, CZ, DA, DB, DC, DD, DE, DF, DG, DH, DI, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DS, DT, DU, DV, DW, DX, DY, DZ, EA, EB, EC, ED, EE, EF, EG, EH, EI, EJ, EK, EL, EM, EN, EO, EP, EQ, ER, ES, ET, EU, EV, EW, EX, EY, EZ, FA, FB, FC, FD, FE, FF, FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FQ, FR, FS, FT, FU, FV, FW, FX, FY, FZ, GA, GB, GC, GD, GE, GF, GG, GH, GI, GJ, GK, GL, GM, GN, GO, GP, GQ, GR, GS, GT, GU, GV, GW, GX, GY, GZ, HA, HB, HC, HD, HE, HF, HG, HH, HI, HJ, HK, HL, HM, HN, HO, HP, HQ, HR, HS, HT, HU, HV, HW, HX, HY, HZ, IA, IB, IC, ID, IE, IF, IG, IH, II, IJ, IK, IL, IM, IN, IO, IP, IQ, IR, IS, IT, IU, IV, IW, IX, IY, IZ, JA, JB, JC, JD, JE, JF, JG, JH, JI, JJ, JK, JL, JM, JN, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX, JY, JZ, KA, KB, KC, KD, KE, KF, KG, KH, KI, KJ, KK, KL, KM, KN, KO, KP, KQ, KR, KS, KT, KU, KV, KW, KX, KY, KZ, LA, LB, LC, LD, LE, LF, LG, LH, LI, LJ, LK, LL, LM, LN, LO, LP, LQ, LR, LS, LT, LU, LV, LW, LX, LY, LZ, MA, MB, MC, MD, ME, MF, MG, MH, MI, MJ, MK, ML, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NB, NC, ND, NE, NF, NG, NH, NI, NJ, NK, NL, NM, NN, NO, NP, NQ, NR, NS, NT, NU, NV, NW, NX, NY, NZ, OA, OB, OC, OD, OE, OF, OG, OH, OI, OJ, OK, OL, OM, ON, OO, OP, OQ, OR, OS, OT, OU, OV, OW, OX, OY, OZ, PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM, QN, QO, QP, QQ, QR, QS, QT, QU, QV, QW, QX, QY, QZ, RA, RB, RC, RD, RE, RF, RG, RH, RI, RJ, RK, RL, RM, RN, RO, RP, RQ, RR, RS, RT, RU, RV, RW, RX, RY, RZ, SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR, SS, ST, SU, SV, SW, SX, SY, SZ, TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO, TP, TQ, TR, TS, TT, TU, TV, TW, TX, TY, TZ, UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ, UK, UL, UM, UN, UO, UP, UQ, UR, US, UT, UY, UZ, VA, VB, VC, VD, VE, VF, VG, VH, VI, VJ, VK, VL, VM, VN, VO, VP, VQ, VR, VS, VT, VU, VV, VW, VX, VY, VZ, WA, WB, WC, WD, WE, WF, WG, WH, WI, WJ, WK, WL, WM, WN, WO, WP, WQ, WR, WS, WT, WU, WV, WW, WX, WY, WZ, XA, XB, XC, XD, XE, XF, XG, XH, XI, XJ, XK, XL, XM, XN, XO, XP, XQ, XR, XS, XT, XU, XV, XW, XX, XY, XZ, YA, YB, YC, YD, YE, YF, YG, YH, YI, YJ, YK, YL, YM, YN, YO, YP, YQ, YR, YS, YT, YU, YV, YW, YX, YY, YZ, ZA, ZB, ZC, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN, ZO, ZP, ZQ, ZR, ZS, ZT, ZU, ZV, ZW, ZX, ZY, ZZ.



Fig. 11. Ward 12, 1960s. Royal Naval Hospital, Portsmouth.

Now, however, the ward has been divided into three 'therapeutic' wards of 12, 12 and 12 beds, each with its own 'ward room' (Fig. 12) since the 1960s.

joined RN, M in 1964 the Department was extensively reorganised and it is now probably the most up to date Department of this sort in the South West. Above it is



Fig. 12. Ward 12, 1960s. Royal Naval Hospital, Portsmouth.

Now the ward is reorganised into three 'therapeutic' wards of 12, 12 and 12 beds, each with its own 'ward room' (Fig. 12) since the 1960s.

A small Lecture Theatre

D Pavilion, which lies between H and E Blocks remains what it always was, the Visiting Room. In former days the Reader held his quarters here. Here also until 1966 was the lecture theatre which the cinema were lodged.

The Auxiliary Buildings

If we now walk around the perimeter road surrounding the main buildings, starting at the Pay Office and moving to the left we will find that the remainder of the hospital site has been built over the years in the direction of expediency by various Buildings. Largely uncoordinated both in form, location and materials. Obviously when these buildings were contemplated the use of the covered quadrangle for development was wisely deliberately excluded. What is it to tell us how



Fig.	Tab.	Notes	Adapted to	Printed on	Printed by	Printed at	Printed on
1	1	1	1	1	1	1	1

From these data, a value of 1.0×10^{-4} was obtained for the rate constant of the reaction of the radical cation with the monomer. This value is in good agreement with the value of 1.0×10^{-4} obtained from the kinetic data of the polymerization of α -methyl styrene by the $\text{C}_6\text{H}_5\text{O}_2\text{Cl}$ system.

mostly these smaller buildings, and both functionally and architecturally to the new buildings.

The first building we saw, at the Ordnance and Services Administration, of yellow brick construction, is here behind the Fire Office and was erected in 1900. A taller building on the east, the housing of the Ordnance (Fig. 17) of similar construction, is also completed and occupied in 1901 (Fig. 18). Behind B. Block as you see our left the stone line, composed of the Houses



U. S. DEPARTMENT OF AGRICULTURE

6. *Journal of the American Medical Association*, 2000; 283: 2686-2692.



1. *Journal of the American Medical Association*, 1997; 277: 1033-1038.

1. *Journal of the American Medical Association*, 1997; 277: 1039-1043.

He got out in prison for Mrs. Redford Smith, the third wife, born in 1915. He lived in Berlin, Germany between 1940 and 1946. Redford Smith was a Car Park Manager at the University and lived at 100, South, 100, South is located, the 100, South, Virginia, born in 1940. I am the owner, incorporated in 1940.

Figure 1

Another way we made the old *Agave* feel like old. The house is still there and

[illegible]

the 1990s, the number of people in the world who are illiterate has increased from 1.2 billion to 1.5 billion. The number of illiterate people in the world is projected to reach 1.7 billion by the year 2015. The number of illiterate people in the world is projected to reach 1.7 billion by the year 2015.



Fig. 39. *Staff Nurses, N. G. Hospital, N. G. Province, 11 March 1956.*

There is a large hall, 100 ft. long and 10 ft. wide, which is used for many purposes, including the holding of dances. It is a very large hall, and is a very good example of the type of building which is built in the N. G. Province. It is a very good example of the type of building which is built in the N. G. Province.

apparently no special accommodation for cases of infectious diseases, particularly tuberculosis. In this year a *Pymble Hospital* was built consisting of four small blocks accommodating fifty patients with



Fig. 40. *The Pymble Hospital, N. G. Province, 11 March 1956.*

After the Pymble Hospital was built, the N. G. Hospital was closed. The Pymble Hospital was built in 1955. It is a very good example of the type of building which is built in the N. G. Province.

a garden for the staff. Modern medicine has increased the need for wards of this sort and two are now used to accommodate a department of plastic surgery under a civilian consultant and the remainder is for out-patients.

In the north-east corner of the hospital on the diagonal Water Tower a reservoir for the forwarding of a back water to cleanse the common sewer. This is the same as it did over two hundred years ago. Close by is the Mortuary Chapel built in 1883 (Fig. 41).

The Chapel of the Good Shepherd

Facing on the land to the east of the Water Tower is the main axis of the hospital, the Chapel of the Good Shepherd built in 1883 (Fig. 42). It has accommodation for 200 worshippers and the interior is bright and pleasing (Fig. 43). The



Fig. 41. *Mortuary Chapel, N. G. Hospital, N. G. Province, 11 March 1956.*



Fig. 43. Protestant Chapel (Fig. 42) built between 1890-1900.
 (Note: the 1900-1901 extension giving form to the tower on the right side.)

Chapel was again damaged by bombs in World War II and a two-light window, a stained glass showing the scene of The Supper in Emmaus, the gift of a grateful patient awarded in 1899 was also destroyed. The reopening of the Chapel on February, 16, 1944 was conducted by the Chaplain of the First The Venerable Archdeacon J. K. Wilson M.A. The interior of the Chapel is decorated with the badge of many ships and the flag were by M.M.H. Copenhagen while serving with the British Pacific Fleet on VE Day VI Day and on August 30, 1945 on her entry into Hong Kong for the surrender of the colony by the Japanese. There is a memorial to the dead of both world wars and a plaque in memory of two Staff South Americans killed in 1941 by enemy action

shooting down in the hospital. Aisle (Fig. 44) in the Chapel has floor from 1890-1900.

Off to the left of the Chapel are two hexagonal pavilions formerly smoking rooms. Behind the Chapel is the Staff Officers' Block built in 1900 (Fig. 45).

The Staff Quarters

The Staff Quarters (Fig. 46) which lie to the south of the Chapel were completed in 1935. Male ratings are accommodated in the west end and naval nurses are accommodated in the east end of this building which also contains an officers' social club. From time to time before the war junior Staff South were accommodated in 1 and 2 Halls. Beyond the Staff Quarters are the hospital playing



Fig. 44. The old building, Jacksonville, Fla., before the war.

Notes: The old building was built in 1901 and was the first building of the Hospital for the Blind in Jacksonville, Fla.

the northeast end of the building, a new building, known as the "new building," is to be made for the purpose of a new of 124,000 sq. ft. and 1 building for the purpose of a new only. Another 270,000 sq. ft. is to be added to the building of the new building for the purpose of a new only one, for the purpose of the new building. To meet the requirements of the new building, a new building is to be erected on the south side of the hospital. In addition to these, new works of the existing building are to be thoroughly renovated to an estimated cost of \$2,000.

This redevelopment, albeit not very pleasing to the eye, has enabled the hospital to continue to play an important role



Fig. 45. The new building, Jacksonville, Fla., after the war.

Notes: The new building was built in 1945 and was the first building of the Hospital for the Blind in Jacksonville, Fla.

in the care of our citizens during the present century.

The World Wars and their aftermath

In World War I a large number of wounded Belgian soldiers were treated in the Hospital in 1914. During the winter war period the Hospital was fully occupied and the Council Board in the High Street was used as an overflow for sleeping accommodations. In the Hospital itself two medical wards were taken over to provide emergency care for additional medical officers and nursing sisters.

In World War II, the situation was even more critical and the part played by the Hospital was vital. During the winter, many of the City of Plymouth men of the Hospital buildings escaped when so much of the surrounding property in Birmingham was destroyed. Even so, 14 bombs of varying types fell on the Hospital between 1941 and 1942 resulting in damage which has already been described. Even this, however, did not deter the staff from giving maximum care to their patients.

In the years that have followed war there have been arrivals from Korea, Hong Kong, India, and more recently from Northern Ireland. The membership of the National Blind Service has led to a further commitment and the Hospital is now undertaking, as much National Health work as circumstances and staffing allow.

The Future

Up to recently a redevelopment study has been undertaken with the object of achieving complete modernization to the standards required by the Department of Health and Social Security while at the same time respecting the historic and environmental features of the existing complex. The more enlightened proposals have been made and there have been good reasons for hoping that the Hospital Naval Hospital

THE ROYAL NAVY MEDICAL CLUB DINNER 1972

The annual dinner of the Royal Navy Medical Club was held in the Printed Hall, Royal Naval College, Greenwich, on Friday September 22, 1972.

The President, Surgeon Vice Admiral James Watt, CBE, MD, MR FRCS, delivered the following speech.

Admiral Empson, Admiral President, distinguished Guest, Members.

It is exactly 150 years today for William Barron brought his considerable talents and his ability to lead upon the Medical Department of the Navy subsequently to become its first Director General. It is therefore entirely appropriate that we should celebrate this important anniversary at Greenwich with the Annual Dinner of the Royal Navy Medical Club for one fellowship together is founded upon its devotion for the Navy and a mutual respect for professionalism in medicine which Barron did so much to foster.

Within a year of taking office medical literature appeared in the Royal Naval Hospital and four years later he had established a system of progressive medical education in Harrier Ness naming his attention to the sailor at sea he awarded a standard analysis of various courts and founded in 1810 the Salt Breth Hall whose unique contribution to the care of the sailor is written into its log and distinguished history and reflected today in the spirit of the Medical Branch young men of today who in ships with me a doctor shoulder greater responsibilities with their officers, landwards and professional staff in welcoming the new Wreckmaster Commander, Commander Clarkson. I should like to pay tribute to his predecessor in office Wreckmaster Commander Vaughan, for the policies and tact

with which he pursued independent policies.

It is said that Barron himself was not over-endowed with imagination yet his thinking for the Medical Service remains as appropriate today as 150 years ago with its concern upon effective administration, progressive medical education, the application of scientific methods to clinical problems and an overriding concern for the sailor at sea. In other words, he recognized that the primary objective of the Royal Medical Service was towards what is popularly termed the ship and the sailor in his position and adverse environment.

The Navy, at that time was on the threshold of change from methods of propulsion and new weapons were to bring new hazards to health. The success of Barron's policies can best be judged by the calibre of the nineteenth century medical officers they aimed at was the future. They became naturalists, miners, loggers, explorers and engineers. They nurtured Richardson, Huxley and Spencer Webb. The journals of these nineteenth century surgeons record the extent of their involvement with the ships and men of the Royal Navy. They charted uncharted territory, they invented systems of sanitation, they read scientific papers at the Royal Society, they conducted clinical trials, they contributed to the medical literature, they became the sailors' friend and had the moral courage to stand out against anything that appeared to them as ethical or unfair.

One hundred and fifty years later the Navy is again in the throes of change. The age of steam has given way to nuclear propulsion, to sophisticated electronic computer-controlled weaponry, the highly

medical assistance, of continuous submergence, a self-sustaining First Air Aid and new industrial techniques, in the naval dockyards. The intention is to present as involved by the new technology and properly the responsibility of the Medical Service of today, together with the clinical care of the sailor and the hospital care of his family, who are particularly vulnerable in the diseases caused by long separations.

In this task we are assisted by the skilled and devoted nursing provided by Queen Alexandra's Royal Naval Nursing Service, which this year celebrates its 75th anniversary and we better return to its nursing standards and upon its corps can be made that the fact that 200 applications are received each year for the 160 places available.

The Navy itself has developed a professionalism which Heretofore would have appeared and its Medical Service has not been slow to catch up. Indeed on July 14 the day which commemorates the storming of the Bunker, Surgeon Lieutenant Scott Perkins passed his pilot's wings. He was a schoolboy first student on course and received the special award for taking top place in the air examinations. He will undertake 12 months flying operations training as an operational pilot before joining the staff of the RAF Institute of Aerospace Medicine. He is the first medical officer to receive pilot training for many years and properly to establish our contribution to the First Air Aid in its new role. This marks Surgeon Lieutenants will enter pilot training next year and one other will start in its career.

The new look in air medicine, which is the target for the vigorous direction of Surgeon Captain Ian Telford, is reflected in a more active role in research and the exchange of ideas. The work of Surgeon Lieutenant Commander Frank Challen, and Professor Harvey on hypoxemia has inspired a timely new training film which

should do much to combat the ignorance which will arise from both at sea and on land.

A number of important symposia, seminars and clinical meetings have been held during the year at the Institute of Naval Medicine, the Royal Naval Hospitals at Haslar and Plymouth and the Naval Air Medical School. I should like to thank Captain Robert Bownman of the United States Navy, who is conducting an exchange appointment at the Institute for his part in bringing sixteen American lecturers to spend on their research programme.

I am glad to report however that we has not been by any means our very traffic for Surgeon Commander David Elliott made space this year to become the first Canadian President of the Undersea Medical Society and very much enjoyed the recent meeting at the Bahamas to which several naval medical officers contributed research papers and at which Professor Kenneth Donald, cardiac consultant to the Navy and well known to many of us here, was awarded the Delfino First. An approximately the same time Surgeon Captain Geoffrey Wells was being a joint Anglo-American Conference and Surgeon Captain Rawlins, with his panel of naval officers subsequently conducted one of the symposia at the 1971 Annual Scientific Meeting. Surgeon Captain John Horneau went the United States to present details of his programme on Asphyxia Bona Nocturna which will provide the basis for a similar study at the United States Navy and Surgeon Commander Norman Worlock lectured at a meeting recently at London on the original research into pre-eclampsia and renal vessel formation.

It is also encouraging to learn that the experience of naval helicopter surgeons in new techniques for the fixation of fractures which they helped pioneer is being in

extremely recognized while a naval aviator in the medical press commemorated the elegant design of the research of Surgeon Captain Wadsworth on schizophrenia and stress.

Several Middles prize were awarded to Surgeon Commander Peter Harrison for his contribution to research in underwater medicine and to the late Surgeon Captain John Cliff, Professor of Naval Medicine whose scholarly death note, the Medical Service of one of its most distinguished and respected figures.

Totally at present, the great pleasure to announce that the Gilbert Sling Medal for 1955 has been awarded to Surgeon Commander Peter Harrison for his research on Asbestos, Cancer which already has won him recognition by London University and the Royal College of Physicians and which has led to a great Royal Navy and Medical Research Council project of the most importance. Members may also like to know that Surgeon Commander Harrison has recently been awarded the coveted Royal Society International Prize for Original Research into Occupational Health and the presentation will be made in May, later this year.

In his terms on Circulation, Sir Alan with Clark and internationalism as an index of the quality of human activity in the field of science and taking this definition the Naval Medical Service of the new era appears to be in a reasonably healthy state. That is borne out by the revealing figures: more cabins, more direct routes and more freedom to a 24 hour command. It is true also of the Dental Branch and the dental cadetship scheme is over-subscribed.

The Division of the Royal Dental Service Surgeon Rear Admiral Hume, reports that the career programme project is now established for all new entrants and that work has commenced on a new training film to reinforce dental health education throughout the fleet. These efforts

have received a happy response with the appointment of Professor R. D. Fisher as Consultant in Periodontology. This year the Navy is responsible for arranging the Joint Services Dental Symposium for Scotland to be held at Perth next week and a symposium on Prosthetics is being arranged at the Institute in December. Surgeon Commander Clappish has recently commenced a two year exchange dental appointment in the United States and we welcome him this evening his opposite number Lieutenant Commander Mack of the United States Naval Dental Corps.

But exchange appointments are only one way in which naval medical and dental officers can continue to combine education with the fun of travel and as many examples of our Surgeon Lieutenants show the Navy continues to offer the excitement and challenge of offered his classmates ordinary counterparts. Tonight there are naval medical and dental officers in Australia, London, Singapore, Hong Kong, on the United States, Naples, Malta, and Gibraltar and in ships during the winter time. An excellent example of ship service is operation, a Surgeon Lieutenant is in charge as medical officer to the *Southdown* expedition another leaves for Pangloss next month with the Joint Services Expedition unit, as HMS *Antelope* recently provided medical assistance to flood victims in the Philippines, another is in the Antarctic as HMS *Porpoise* and yet another happens at the moment to be with the *Alpin* in the Alps. There are the trained, energetic young men the Navy needs, with the potential to translate reason and achieve them. What have we to offer them?

I am sure that you will expect me to say something of the two committees set up to do precisely this for us, but regrettably I am not yet in a position to do so because although the Armed Forces Committee on Postgraduate Medical and Dental Education has now made its first report. On

implications which I may say are considerable are still being studied in the Ministry of Defence. The Defence Medical Services Inquiry Committee continues to ask questions, indeed often the same question in different aspects of the information supplied to it and it will now be poised to report next Spring. So we find ourselves at this juncture at the problem of the extent of a lecture before it is a refuge for warming with buried truth while the superficialities of our times, easily misinterpreted, are partially pondered to prepare an unambiguous message to some dark stranger.

Of one thing however I am absolutely certain and that is that any form of message to authority is to be feared upon at first I sincerely hope that there will be emphasis upon collaboration between the three Services particularly in those fields where I believe that collaboration is its essential post-graduate education research and clinical application. The sharing of our very considerable resources in these areas can bring nothing but lasting benefit to us all. The chief thing which I hope the Committee will do is to recognize the need and refer to the Navy all the environmental questions and that it will recommend the maximum number of speakers and convenient points for which the Director of the Environmental Medicine has been campaigning and which I am now vigorously representing.

Meanwhile there are tangible evidences to the young man who wishes to make the Navy his career that his future is assured. The Royal Naval Hospital, Haslemere is about to embark upon an expenditure of £1 million building programme which will provide new training facilities, staff accommodation, new wards and a canteen; and I should like to pay tribute to the efforts of those committees who at great personal cost have worked long into the night to shape the right kind of future for several

top gentlemen. This is of course what nursing committees never are.

The new Institute is also beginning to take shape with the completion of the environmental health laboratories sure to be followed by a unique submarine medicine unit to study long term neurological, chemical and psychological stresses on post-graduate medical course and a variety of new laboratory facilities.

The National Health Service has recently accepted the hospitality of the Royal Naval Hospital, Haslemere and opening a House Surgery Unit within its walls. The hospital there has acted as a new student and emergency unit and provides a service for local civilians so that both major hospitals now between it the same way and with a number of patients of clinical interest to District General Hospital of the National Health Service. And what a satisfying measure to headmaster the Health problem has at last been successfully resolved and we were fully back in business on September 1 although I am proud to understand that of our boats anticipated that visit by 48 hours!

My experience at the Haslemere hospital has to me the need for a single coordinating authority for naval and post-graduate medical training and for career planning and I have asked the present Dean, Surgeon Rear Admiral O'Connor to set up the necessary administrative machinery to deal with this at the Institute and the Dean will chair study selection boards.

It is also worth me that after 120 years you might think that the administrative machinery of the Medical Department itself was in need of overhaul. With the approval of the Naval Sea Lord I have arranged for an examination of the organization and structure, the allocation and disposition of work and the keeping of records in the Department of the Medical Director General. I hope to have a report before Christmas.

more and less still give the impression that the progress (or otherwise) happily undisturbed I interpret, that these various conclusions may well show a need to re-view the whole field of medical administration from within the context of the changing structure of the Navy generally.

There is, however, one field which has caught my general interest, but which, as long as it now appears capable of modification, I refer to the need to provide general duties officers with a satisfactory clinical practice and a rewarding career. Recently our Captain Admiral in General Practice Dr Basil Brier and I reviewed a number of alternative proposals before finding one which has the merit of relative simplicity and which we hope to see in the near future as a pilot training scheme for more general applications.

When we have been able to do that, and I am confident that it is attainable, we shall not need to apologise for any aspect of the Royal Naval Medical Service. In the 1950s your uncle Sir William Barron as First Director General its professional standards and its contribution to research and clinical practice have never stood higher.

Before turning to our guests, I should like to record my acknowledgments to my predecessor in office, Sir Eric Lindbury, for the legacy of goodwill I have inherited. He ruled the waters I must now cross, that they run in the right direction.

The Director thanked the Admiral Treasurer and all who had helped in the arrangements for the dinner and then welcomed the official guests. In particular he welcomed the group of young Admiral Derek Empson, Chief of Naval Personnel and Second Sea Lord saying:

Admiral Empson's distinguished career had its centre in Chatham where he earned his Blue in stripes. I am particularly intrigued to learn that he was a university footballer because it is common-

lyly apparent to me that we shall require his particular expertise if we are to take on our share of the issues which the various committees currently studying our running form may place in our path, although perhaps it is not quite polite in the company to suggest that we might thereby pass the edge over our competitors.

Admiral Empson flew to a job in the Fleet Air Arm during the War and he has spent almost all his career in the air world. He is, therefore, well placed to appreciate the technical advances which are determining the shape of our modern research oriented Medical Service, but he has had ample opportunity as Flag Officer Aircraft Carriers and Commander the Fleet Fleet, of evaluating the standards of clinical practice too, and at moments where good doctors are most needed. These experiences I feel sure will have enabled him to recognise the value to the Navy of medical care for the whole family of the family and to be persuaded that:

That is a matter with which, in his present appointment as Chief of Naval Personnel and Second Sea Lord, I know he is deeply concerned and I am grateful to him for demonstrating his warm interest and support for the Medical and Dental Services by sponsoring us readily to be raising our game of house this evening.

I should however declare that he has a more personal reason for gratitude to naval doctors. As Captain of HMS Ende he found he was in danger of spending his entire command in a permanently damaged state since he severely struck his head on the bulkhead when being rescued. He therefore arranged to be preceded by the air force air Surgeon Lieutenant who acted as a go-between group and married by Captain being so dark.

Members of the Royal Navy Medical Club I ask you to rise and drink to the health of our Guests.

In his reply Admiral Derek Empson:

Chief of Naval Personnel and Second Sea Lord...and

In this job I am responsible for men and I am happy to say women too, and everything which concerns them in the Navy so it is only right and proper that I should say a few words about them and about the responsibilities and opportunities which as I see it fall to the Naval doctor. That sounds a bit pompous but it isn't meant to be.

There are two points I would make first one is that nothing in the incredible scientific progress of recent years has reduced our reliance on the man — in fact it has demanded a much higher quality even if on slightly smaller numbers — and the most valuable piece of scientific equipment is still the man. Secondly he is now very expensive to support but with a few figures in spite of a 20 per cent reduction in Service manpower the proportion of the Naval budget we spend on men has in just seven years risen from 42 per cent to 54 per cent — in the US Navy it is now 62 per cent — if this process continues unchecked we run the risk of ending up with plenty of men but nothing but bones and nerves to run them with!

So it is absolutely essential that we do not waste any of this personnel and most expensive manpower and that we cut down to the minimum the amount of time and effort we have from medical psychological disorders in any other case. This is where our Medical Services have made a real part to play not only in prophylaxis and medical medicine but in a welfare advisory and further confidence rate too. The average age of marriage in the Navy today is 21.7 and we all know the stress which the pattern of Naval life inevitably imposes on young and teenage women — and so on their husbands — however much we do to reduce them. If we want happy men we must have happy wives and there is a lot of talk in the saying that our manpower

hasn't (R.I.) risen or lost in the Marine Parade...I believe we would make real progress with these problems if we could look after our families in that country with our own doctors, on the other two Services do it would cost money of course and already we spend in the order of £11m a year on our medical Service so if we were to expand substantially our hospitals and keep our equipment up-to-date that is another compelling argument for the widest economy in manpower — and in everything else.

I am afraid that what I have said so far must sound to though I repeat men is mainly expenditure on expensive items of equipment. There are of course some rare items, ranging from atomic performance checks to the acceptance of progressive deterioration in performance with age and of course your profession has already played an important role in the replacement of men by equipment. But I don't just do not look upon men and women in this light nor I know do any of you.

I have been naval medicine at work for 11 years now and have seemed to be grateful to our division on many counts. I have been amazed by the progress and change for the better and by the great increase in the contribution Medical Officers make towards the well being in general of our people. The changes that have taken place in the last 10 or 12 years are hard now to believe but they have reached a point where, as Captain of a Cruise I had a PMO who was not only an extremely cautious expert, a qualified pilot a very good GP but was also the first man in the ship to whom sailors would take their troubles — of every sort and risk advised. My only anxiety is that this great advance of professionalism should not lead anyone to concentrate solely on the medical aspects of life and overlook the fact that he belongs to the Navy and so does his loyalty. I have recently noticed a tendency among

and in the younger men's life play down and deplore the fact that they belong to and are involved in the Navy and that is not healthy—and I know that you like President Lusk, with me and neither you nor I will accept it—and I will tell you why.

We are all facing a great challenge in the Navy today. We have to make it, as the only truly volunteer Navy in the world, a Service which young men want to join and stay in and in which they can take real pride and satisfaction. If we don't achieve this, we shall be out of men and we are all bankrupt—and so it is up to all of us, regardless of Branch Line, rank or

with special respect to Junior Line Officers, and prove that the standards of leadership and management in the Navy today are higher than ever.

We must place top of our program a definite and constant interest in and concern for people and an understanding of our fellow officers and sailors. We must also take the trouble to learn about the Navy in all phases. If we don't naturally have these attitudes, we must work hard at developing them, for they are essential ingredients of the leadership which today may need a rather different style but has never been more important.

It will not be long until we are able to provide a more complete description of the system. In the meantime, we are confident that the system will be a valuable addition to the existing literature on the topic. We are grateful to the reviewers for their helpful comments and suggestions. We are also grateful to the editor for his/her support and encouragement. We hope that this paper will be helpful to other researchers in the field.

A. Huxley & Charles D. Cox, *A New Orthography for Street Grammar and Schools*, pp. 60. Edinburgh and London: Chambers, Livingstone, 1880.

and mutual trade with a clear and common
end and purpose of good will to the trading
body which has beyond question and of help
in the understanding of a very complex subject.

W. A. DAVIS

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A. *Leontopodium* grows in all mountainous situations above the forest zone, and occasionally below it, and possibly, in all places, as in good exposure, but will also be found just below the forest zone, and even in the forest zone, as in mountainous regions.

Mr. James Farley, General Editor, Independent Tribune, a New York, is writing a book which will examine the inner history of international capitalism from 1914 to the present, and is said to be a sample of material through in not completely in agreement with the idea, seems to be supported in approximately of any reader has the kind knowledge of such materials. The latter would be glad to hear of them so that he can pass the information to his Farley.

LETTER TO THE EDITOR

Quintessence in Serving Surgeon Lieutenants in Their own entry course.

October 1972

The Postgraduate Studies Committee recommended early in 1972 that the New Entry Medical Officers' Course be investigated to make sure that it bore relation to needs. To this end quintessence was sent out to Surgeon Lieutenants in the Fleet asking for comments on the courses they took in the light of subsequent experience. There follows a brief comment on the results, delicious from which may be any implementation where possible.

At the time of writing nearly one hundred quintessences had been analysed and the officers who wrote in the trouble to make their replies of help to course organisers are thanked.

We spend time looking and thinking. Collapsing pills and wondering about their usefulness or validity, so it is a pleasure to record that the analysis was of considerable merit. A few salient points will be mentioned especially where they reflect on the changing roles of things.

That the dental course was viewed with disfavour was an understandable reflection of the fact that so many Surgeon Lieutenants were ex dentists and had previously done a similar course. In future RMC Officers it is to be the view and we hope that there are doctors who really feel they have become Naval Officers

An all round demand for more practical toxicology and dermatology and a lean towards more tropical medicine, not only shows that our frigates undoubtedly go longer, but also that medical schools do not place much emphasis on these subjects in syllabuses today.

Those who had had the benefit of Royal House jobs probably enjoyed them but found the subsequent career to some extent superfluous.

The fact that a further 45 identifiable superior comments are recorded not only shows that no two doctors think alike but also that the Navy provides a spectacular variety of jobs. Toxic examination appears however to be a universal barrier and Lieutenants felt the need for more experience.

One particularly liked the answer in reply to the question "how long did you have to wait before starting courses?" and the Cheaters got who remarked while smiling, that he had noticed no disadvantage arising from the fact that he had done no courses on entry. Finding that there was only one request that "look keeping his white courses" he concluded merely shows that a sufficient knowledge of the subject matter is still the due to day instead of a medical student's life.

The subject will form the basis of a review of the syllabus at present being considered. A portion of the questionnaire we hope measures those who wonder what happened to them. O. A. S. C. M.

TRANSFERRED TO PERMANENT LIST

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 MB B. S. D. S. (London) MB B. S. (Edin.)
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MEDICAL SERVICE OFFICERS

To Commence (MBs) T. E. Christie (RAF) 1958/4

To Commence Contributions (MBs) J. L. M. G.

To Commence (MBs) R. M. Jones (J. Jones)
 To Starting With Contributions (MBs) J. R. Miller (J.)

Resignations

Surgeon (MBs) J. L. Goss
 Surgeon (MBs) J. L. Goss
 Surgeon (MBs) J. L. Goss

**DEATH: ALEXANDER ROYAL INGRAM
 MEDICAL SERVICE****New Entries**

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 J. A. B. Goss C. Goss M. C. Goss

ROYAL NAVAL RESERVE**Resignations**

To Surgeon (Lieutenant) Commander (J. M.)
 Surgeon MB ChD (RCP) J. J. Goss
 MB B. S. (Edin.)

Former Permanent (RCP)

Surgeon Lieutenant Commander (J. E. Telford)
 MB B. S. (Edin.)

Resignations

Surgeon Lieutenant Commander (J. E. Telford)
 MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.)
 J. L. J. Telford MB B. S. (Edin.) MB B. S. (Edin.)
 J. E. Telford MB B. S. (Edin.)

The following appointments were made on July 2, 1957:
 Surgeon (RCP) J. J. Goss (RCP) MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.)
 MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.)
 MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.) MB B. S. (Edin.)



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THE

PROGRESS OF

THE

ARTS AND

MANUFACTURES

IN

THE

UNITED STATES

OF AMERICA

FROM 1790 TO 1860

BY

JOHN R. KELLOGG

OF THE

AMERICAN ANTHROPOLOGICAL INSTITUTE

NEW YORK

1860